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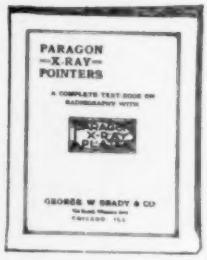

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THE AMERICAN JOURNAL OF ROENTGENOLOGY

Editor, James T. Case, M.D., Battle Creek, Mich.

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ROENTGENOLOGY OF THE HEART*

BY A. W. CRANE, M.D.

KALAMAZOO, MICH.

THE heart is singularly adapted to the roentgen examination. A dense organ with definite margins surrounded by tissues of extreme porosity form ideal conditions for plate or screen. The stomach must be outlined by the opaque meal; the pelvis of the kidney must be defined by a contrast solution; but the heart is outlined and defined by nature ready for the roentgenologist. And yet the roentgenology of the heart is almost completely overshadowed by other clinical methods of examination.

This is less remarkable when we look at the matter from the viewpoint of the clinician. The diagnosis of heart lesions forms one of the most brilliant and satisfactory chapters of medical achievement. The training of the ear, eye and sense of touch for this work has long been a cornerstone of medical education. In addition, instrumental means of extraordinary diversity and precision are in practical use. The finger on the radial pulse and the ear to the chest have commonly been amplified by the sphygmograph, the stethoscope and the blood-pressure manometer. Polygraphic tracings are capable of showing simultaneously the arterial pulse, the venous pulse and the apex beat, with exact time relations. To this may be added, if desired, a graphic representation of the valvular sounds or a simultaneous record of the systolic and diastolic blood-pressure.

The polygraph proved to be an epoch-making instrument but it has in its turn been overshadowed by another device, the most delicate and precise of all clinical instruments, the electrocardiograph. The work of the two auricles and of the two ventricles of the heart is recorded in definite clearly-read curves, either at the bedside of the patient or at some distant point.

Vierordt constructed the first sphygmograph and took the first pulse tracings. Jaquet and many others improved the instrument and interpreted tracings. But until very recent years sphygmographic and cardiovascular tracings were ridiculed as playthings and without place in serious clinical medicine. Fortunately we are not all conservatives and the work was carried on notwithstanding by McKenzie, Wenckebach, Erlanger, Lewis Einthoven and others, who were thus able to interpret the anatomical discoveries of Kent and His. Thus the despised plaything led to a recreation of our conceptions of heart pathology. A voluminous and fascinating literature has sprung into being and with it a

*President's Address, American Roentgen Ray Society, Seventeenth Annual Meeting, Chicago, Illinois, Sept. 27-30, 1916.

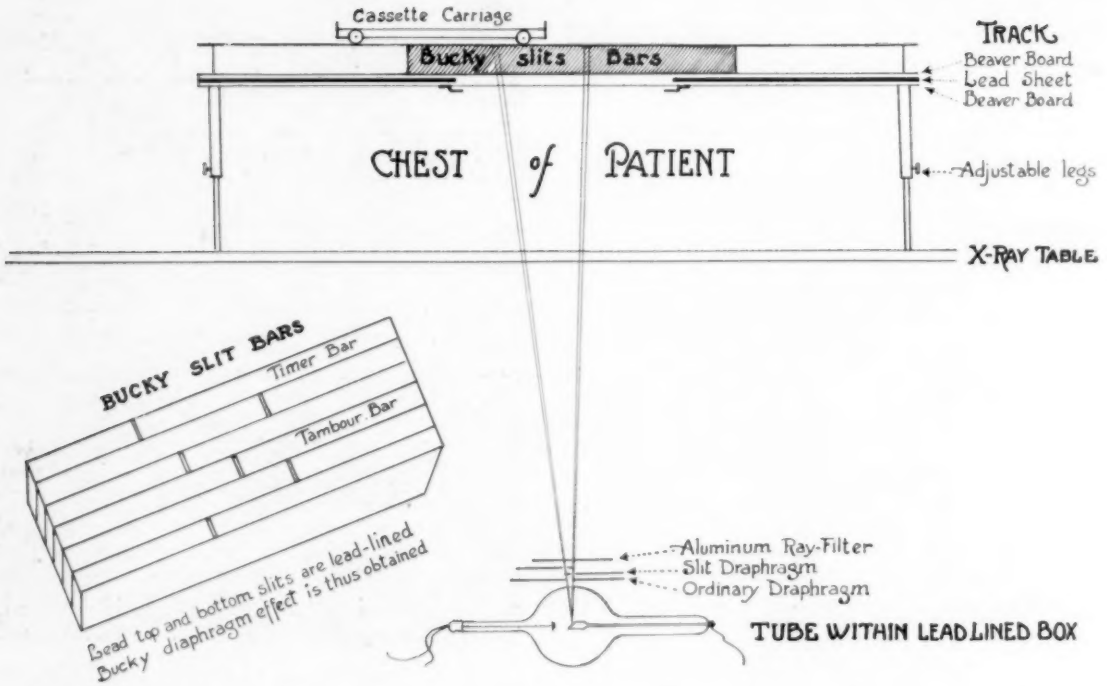

FIG. 1. DIAGRAM OF A DEVICE FOR MAKING SIMULTANEOUS TRACINGS OF THE PULSATIONS OF HEART CHAMBERS AND OF THE AORTA.

new nomenclature. Thus we have become familiar with such terms as the sinus node, the auriculo-ventricular bundle of His, heart block, the Stokes-Adams syndrome, alternation of the pulse, auricular fibrillation, auricular flutter, and extra-systoles.

So it is that in the office of specialist, or in a well-equipped hospital or sanitarium, the need of an *x*-ray examination of the heart may not be acutely felt. In one particular the roentgen examination has long been acknowledged to be unrivaled; namely, in giving the size and shape of the heart. And the expert clinician, jealous of the resources and traditions of his art, has yet been willing to submit his findings in certain cases to the testimony of the screen or plate. Also in the matter of aortic dilatation and aneurism, so closely related to heart pathology, the *x*-ray has been recognized as supreme. But in the matter of valvular lesions and cardiac arrhythmia the *x*-ray has not been a court of appeal.

It is my purpose to-night to show that the *x*-ray may be of great assistance in the study of valve lesions and may be constituted a final court of appeal in cardiac arrhythmia.

In 1912 Gocht and Rosenthal published a method of making polygraphic roentgen-ray tracings of the movements of the heart. The term roentgenkymography was applied to the method. The translation of this paper in the AMERICAN JOURNAL OF ROENTGENOLOGY is the only literature on this subject that I have been able to find. This paper seems to have dropped into that oblivion of scientific archives from which so few ever return.

In a previous paper on this subject I replaced the term roentgenkymogram by the term roentgenocardiogram so as to preserve a uniformity with the accepted term electrocardiogram.

The roentgen tracing of the heart means to most medical readers a tracing of the outline of the heart presumably by an orthodiograph. The roentgenocardiogram, however, is a tracing of the heart beat obtained by covering the heart with strips of sheet

lead so arranged that a narrow slit in the lead can be adjusted over the pulsating margin of the cardiac silhouette as viewed by the roentgen ray. Several of these slits can be adjusted simultaneously over different areas of the pulsating heart, the aorta and the pulmonary vein. A photographic film on a screen in a cassette is then made to travel at a given speed, transversely over these slits, while the roentgen ray is turned on. The result is a tracing which is similar to and comparable with a sphygmogram, a polygram or an electrocardiogram.

My own work in roentgenocardiography has been done with simple crude apparatus made by myself. It remains for some instrument maker to supply us with a properly constructed roentgenocardiograph. It should consist of a lead-covered table, having an open square of 8 inches in the middle. It is convenient to use 10 by 12 films in cassettes. The cardiographic table, therefore, should have a lead covered length of 12 inches beyond the opening in each end. This makes the table 32 inches long. The legs of this table should be adjustable so as to allow the table to be placed over the recumbent patient without touching the face or abdomen. A track and carriage allows the film to travel from one end of the table to the other over the opening. The carriage should be provided with a clockwork or motor which will give several speeds to the second. The average speed required is 5 cm to the second. An accurate timing device is desirable, but an accurate timer of an *x*-ray generator may be utilized so that a centimeter rule may be laid along a film to give time divisions if, for example, exactly 50 cm of film have taken ten seconds of roentgen-ray exposure.

Instead of a table and carriage, we may use a lead-covered cylinder on which is rolled the intensifying screen and film properly protected from light. The rotation of the cylinder over a single long slit will provide the mechanical requirements, in a very compact form, for simultaneous tracings of the pulsations of the right auricle and left ventricle.

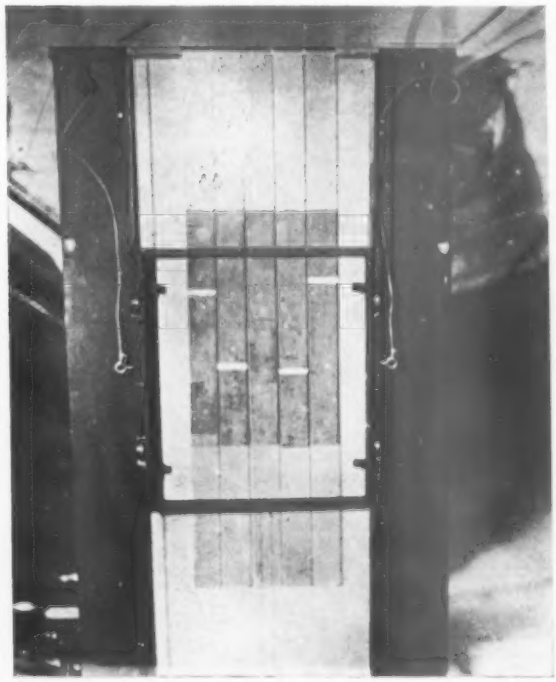

FIG. 2. SHOWING SLIT BARS AND CARRIAGE WHICH HOLDS THE CASSETTE.

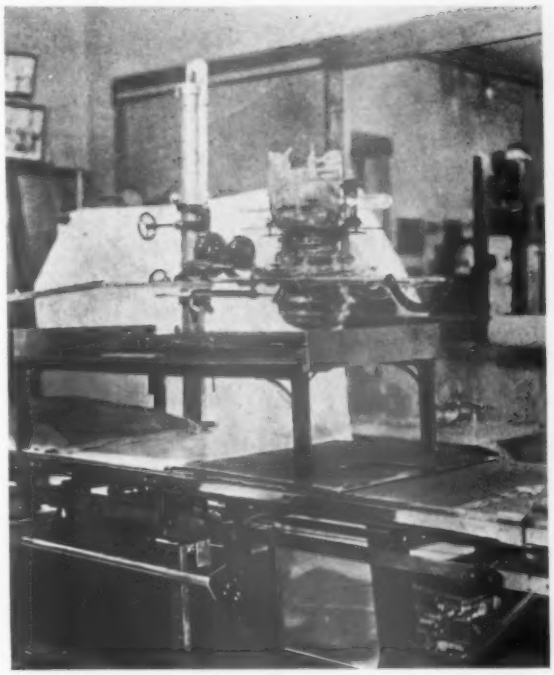

FIG. 3. ROENTGENOCARDIOGRAPH UPON X-RAY TABLE.

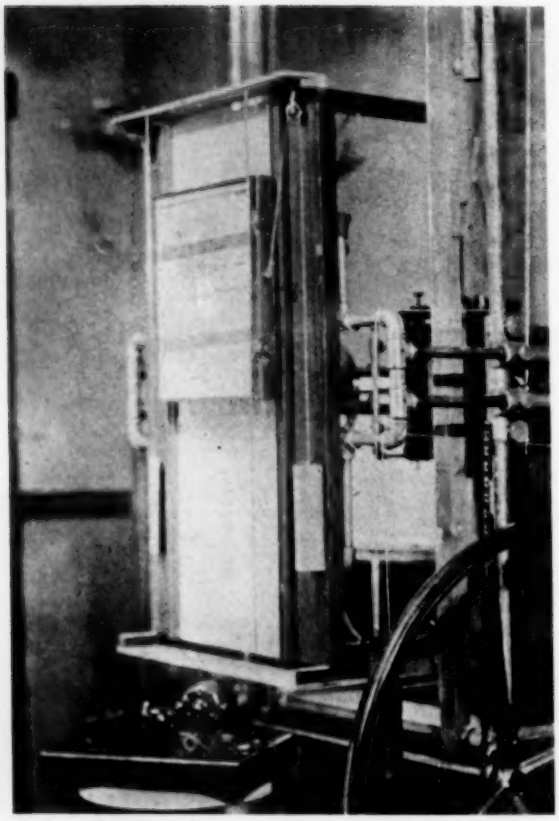

FIG. 4. ROENTGENOCARDIOGRAPH ATTACHED TO UPRIGHT TUBE STAND.

It is obvious that the narrower the slit or the faster the speed of the carriage, the sharper will be the line of the heart tracing, provided the roentgen-ray exposure is properly measured. The average width of slit which is practicable is found to be 2 cm. The slower the transit of the film, the narrower may be the slit while preserving the same roentgen-ray exposure of the film.

If the film travels 5 cm to the second and the slit is 5 cm wide, then the exposure of the film will be one second. But one-fifth of a second is sufficient for a film on a screen in a cassette, and our slit may therefore be 1 cm wide. But 2 cm is an average which gives good definition and allows more latitude for differences in patients. In my experience, a medium focus Coolidge tube, set for a 5-inch spark gap and 33 milliamperes, will stand the run for ten seconds without trouble. The distance of the anode from the film should average 24 inches.

In order to adjust the slit bars it is necessary to use the fluoroscope screen. Two to three milliamperes with a tube set for a 7 or 8-inch spark gap is ample. A three mm aluminum filter should be used to increase the time limit for observations. The erythema dose of roentgen rays is stated to be 25 milliampere minutes with an 8-inch skin distance, a 9-inch spark gap and 3 mm of aluminum filter. At 16 inches this would give 100 milliampere minutes, since the quantity of the rays decreases with the square of the distance. Thus, if we are using $33\frac{1}{3}$ milliamperes, we have three minutes of safe exposure. One-half minute of this time will allow three tracings of ten seconds each. We thus have 83 milliampere minutes remaining at our disposal. A small fraction of this time will have been used to examine the pulsating heart and to adjust the slit bars, leaving a wide margin of safety. The fact that the patient may be turned in other positions for additional

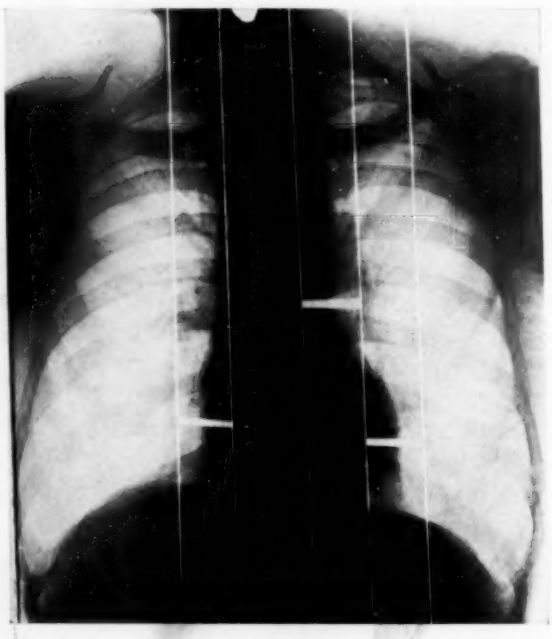

FIG. 5. SHOWING SLIT BARS IN RELATION TO ROENTGEN IMAGE OF HEART SO ADJUSTED AS TO RECORD MOVEMENTS OF LEFT AURICLE AND VENTRICLE AND RIGHT AURICLE.

tracings gives the opportunity for repeated observations within the limits of safety.

The use of a narrow slit of roentgen ray provided by the slit diaphragm greatly extends the time limit of safety. Different sections of the heart silhouette may be used with each tracing, so as to give added information. This exposes new skin areas each time. The use of the film between two screens greatly lessens the exposure time. By these precautions the number of tracings permissible with safety would be beyond any number required for practical purposes.

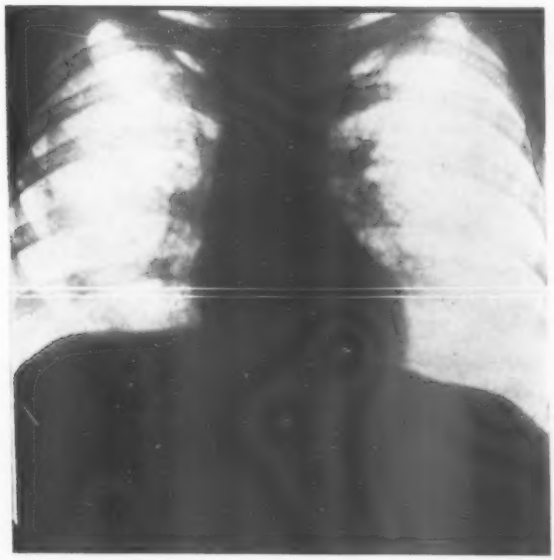

FIG. 6. SHOWING SINGLE TRANSVERSE SLIT FOR TAKING TRACING OF LEFT VENTRICLE AND RIGHT AURICLE.

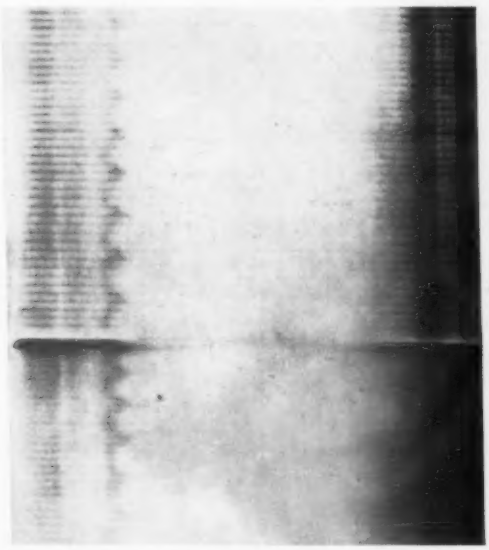

FIG. 7. ROENTGENOCARDIOGRAM OF LEFT VENTRICLE AND RIGHT AURICLE MADE BY MEANS OF A SINGLE TRANSVERSE SLIT.

The electrocardiogram, as you all know, is a tracing obtained on a strip of photographic film which moves across a slit. Running at right angles to this slit is a very fine metallic filament which vibrates with the electric currents excited by the heart muscle. An electric light behind the filament prints the vibrations on a moving film. A microscope is arranged so as to magnify these vibrations and thus yield a tracing having the requisite amplitude.

In the case of the roentgenocardiogram the wire filament is replaced by the edge of the heart muscle itself and the light is replaced by the roentgen ray. There is no other essential change. No microscope is required.

In the electrocardiogram we deal with the electrical changes in the heart; in the sphygmogram or polygram we deal with pressure variations within the blood-vessels (excepting in the case of the apex beat); but in the roentgenocardiogram we deal directly with the movements of the heart muscle. The electrocardiogram is stated to give a record of both auricles contracting as a unit and of both ventricles contracting as a unit. The sphygmogram or polygram gives records of the venous pulse and the left ventricle. But the roentgenocardiogram is capable of giving a separate record of the muscle movements of each chamber of the heart. In this respect it stands unrivaled.

Tracings have been obtained experimentally by connecting the nose with a tambour and having the subject hold the glottis open during suspended respiration. Also tracings have been obtained from a rubber tube in the esophagus. The claim

has been made that these tracings represent the pulsations of the right ventricle and the left auricle. But it may be stated that the roentgenologic method is the only one which can furnish unquestionable tracings of these separate chambers of the heart, and produce them so as to be clinically practicable.

The disadvantages of the roentgenocardiograph are:

1. Very large, heavy patients offer resistance to the passage of roentgen rays.

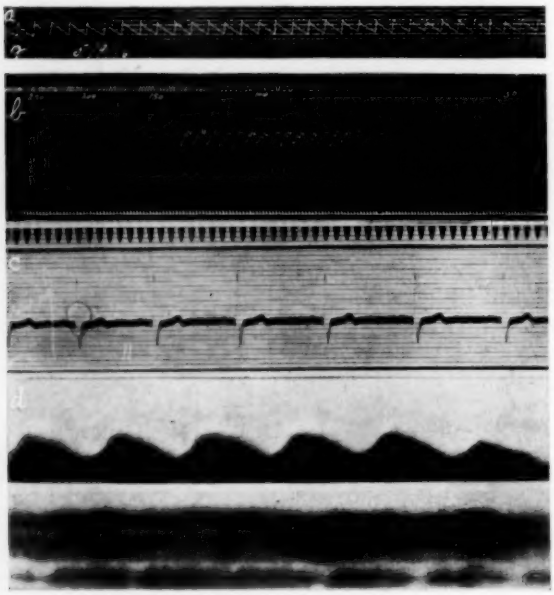

FIG. 8. COMPARISON OF DIFFERENT KINDS OF TRACINGS.

(a) Sphygmographic tracings of radial pulse. (b) Polygraphic tracings of venous pulse, arterial pulse and blood pressure. (c) Electrocardiogram—normal. (d) Roentgenocardiogram of left ventricle and left auricle.

This is overcome by using wider slits, a slower movement of the carriage and a ray of higher penetration.

2. Some patients with cardiac disease cannot lie in the horizontal position. This difficulty can be overcome by the sitting position, in which case the patient is placed with the back against the lead screen of the cardiograph and with the tube in front. Each slit must then be adjusted over an interspace between ribs, and special pains must be taken to immobilize the patient.

3. Patients with advanced tuberculosis, pneumonia or pleuritic or pericardial effusions are not suitable for roentgen tracings, because the outline of the heart is obscured or actually concealed. Dense deposits at the hilum of the lung running downward along the heart border usually are an advantage rather than otherwise, because there is a narrow clear space between the heart and these deposits which improves the tracings.

The eye cannot follow accurately the simultaneous movements on the screen of three different chambers of the heart. Two, however, can be followed with a little practice. Why then make tracings? The same question arises regarding sphygmographic and polygraphic tracings. It has been urged repeatedly that the finger on the pulse feels everything which the sphygmograph records. Furthermore it is easy to fasten a broom-straw by adhesive plaster over the right jugular of a patient in the horizontal position so that the venous pulse multiplied by the length of the straw is plainly visible to the eye. Then with a stethoscope over the heart and the finger on the radial pulse, the simultaneous action of the venous pulse, the arterial pulse and the apex beat can be studied without tracings. Nevertheless the fact remains that the progress was not made in the study of arrhythmia until tracings were made. The power of deliberate study, the registration of minute variations, and the accurate comparison of many cases made the tracing indispensable.

The function of the roentgenocardiogram in practical work may be appreciated when we consider the roentgen signs of heart disease.

I will consider in one group regurgitation through the mitral and tricuspid valves and stenosis of the aortic and pulmonary semilunar valves because these four lesions yield systolic murmurs.

In a second group I would place stenosis of the mitral and tricuspid valves and regurgitation through the aortic and pulmonary, because these lesions yield diastolic murmurs.

In a third group may be placed the combined lesions which yield a confusion of murmurs.

When the physician hears a systolic murmur, his first presumption is that a mitral insufficiency is present. Just as most skin lesions are called eczema and most stomach troubles gastritis, so most heart lesions giving a systolic murmur are called mitral insufficiency. The systolic murmur, however, may be due to a tricuspid insufficiency or to a stenosis of either the aortic or pulmonary valves. The differentiation depends chiefly upon the localization of the maximum murmur. A differentiation which is clear and convincing in a book or class room proves to be otherwise in actual practice.

When the heart with a systolic murmur is observed by the *x*-ray screen, if we see that the left auricle is dilated and that at each contraction of an enlarged left ventricle there is a quick, forcible pulse of the auricle then we have noted the roentgen sign of mitral regurgitation.

If at this point we make a roentgenocardiogram of the movement of the left ventricle and left auricle, we will see usually the ventricular curve of hypertrophy and always the ventricular type of the left auricular pulse.

Likewise in the tricuspid regurgitation we find a ventricular pulse in the right auricle with right auricular dilatation. Since the two ventricles contract together, the two sides of the heart may be viewed anteroposteriorly through a narrowed diaphragm so as to compare the time relations of the auricular and ventricular beat. The polygraphic tracing of the venous pulse in the neck and the simultaneous tracing of the carotid show exactly the same phenomenon.

If now we make a roentgenocardiogram of the right auricle and the left ventricle, we will demonstrate the ventricular type of the auricular beat which is the unequivocal sign of regurgitation or of nodal rhythm. It must be remembered that a large tricuspid regurgitation gives no murmur, although a small regurgitation gives a distinct murmur. The jugular pulse in the neck will usually tell the story. But this lesion is particularly liable to be overlooked and the roentgenologist has here an especially good opportunity to demonstrate a valve lesion which the stethoscope can not always discover.

If neither auricle shows dilatation nor the ventricular form of pulse, then stenosis of the aortic or pulmonary openings must be considered. In the case of aortic stenosis we find a marked hypertrophy of the left ventricle which is in striking contrast to the absence of enlargement in other parts of the heart, particularly of the left auricle and the aortic arch. In the case of pulmonary stenosis the enlargement is confined to the right ventricle and is not likely to be observable in an anteroposterior view, so that we will see a heart shadow which is conspicuously small in comparison to the eccentric hypertrophy of aortic stenosis. This is usually a congenital defect, and the small heart associated with pulmonary tuberculosis is frequently the heart of pulmonary stenosis.

The roentgenocardiogram in cases of aortic stenosis will show the tracings of left ventricular hypertrophy in contrast with a small normal auricular pulse, whereas the roentgenocardiogram in pulmonary stenosis shows a normal small pulse of all chambers excepting the right ventricle, which must be viewed in the lateral position. In this lateral position the auricular pulse at the back of the heart is particularly well observed.

Cases with diastolic murmurs form our second group. Mitral stenosis always means dilatation of the left auricle without hypertrophy of the left ventricle, but with hypertrophy of the right heart. These points are easily observed on the screen.

Tricuspid stenosis is extremely rare and is almost never recognized during life. The right auricle is markedly enlarged but shows no pulsation, which facts are easily observed on the screen. I have never seen a case but feel satisfied that the *x*-ray findings

would so supplement the physical findings as to make the diagnosis clear.

In aortic regurgitation we have the maximum dilatation or hypertrophy of the left ventricle. In no other cardiac affection is the heart so large. Although presenting marked clinical features in well developed cases, yet this lesion is often accidentally discovered in life insurance examinations in persons who are unaware of any heart disease. The ease and certainty with which this lesion can be diagnosticated by purely clinical means does not detract from the value of the *x*-ray examination. The accurate measurement of the size of the heart by means of the orthodiagraph or better by teleroentgenography is here of real service in prognosis and treatment.

The roentgenological signs are enlargement of the left ventricle with marked pulsation of the aortic arch without abnormal pulsation of the auricles. The roentgenocardiogram in aortic regurgitation should show the pulsations of the aorta, left ventricle and right auricle.

Pulmonary insufficiency is so rare as to be negligible. Although I have never studied a case, I believe that the *x*-ray signs would be more conclusive than the physical. An enlargement of the right ventricle could be made out by lateral inspection and a marked throbbing of the pulmonary artery could doubtless be seen. These signs would effectually differentiate this lesion from aortic regurgitation. This differentiation cannot be made by the stethoscope, as a rule.

The combined lesions of two or more valves greatly increase the complexity of the clinical diagnosis and likewise of the roentgenological. Unfortunately, combined lesions are extremely common. Mitral stenosis is likely to be accompanied by imperfect valve closure, which means regurgitation. This is true of stenosis in general. Regurgitations are likely to cause other valvular disturbances in time.

The cardiac silhouette in health and in various diseases has been described by Groedel and others using the orthodiagraphic and teleroentgenographic methods. Groedel attempted to describe the topography of the inside of the heart also, in its relations to the roentgen examination. He showed the inside markings of the empty heart but regretted that he could not show the position of the valves with the heart *in situ* as seen in the living subject. This difficult undertaking was successfully accomplished by Dr. LeWald by one of the most remarkable pieces of roentgenological research ever accomplished.

Most of you are familiar with LeWald's beautiful plates of the heart. A study of these plates stereoscopically gives a vivid and correct idea of the relative position of the four great heart valves to each other and to the heart outline. The difficulty of discriminating between different heart murmurs which originate in such very close proximity to each other enables one to understand the differences of opinion which occasionally arise among able clinicians over valve lesions. Balfour has called the pulmonary valve area on the chest the area of "auscultatory romance." We will notice that this area is close to three of the four great valves as shown by LeWald. Osler describes five different causes of murmurs heard in this region when no heart disease exists.

The essential points in the *x*-ray examination are (1) the detection of dilatation or hypertrophy of certain chambers of the heart; (2) the character of the pulse of various heart chambers; and (3) synchronism of different chambers. There must be at least two factors in each case for differential purposes.

Cardiac roentgenology may be condensed into sign and symptom complexes similar to the Holzknecht symptom complexes of gastric roentgenology.

Symptom Complexes.
Cardiac Roentgenology.

Group A, with Systolic Murmurs.

I. Dilatation of left auricle.
Hypertrophy of left ventricle.

Ventricular type of the left auricular pulse.
Diagnosis: Mitral regurgitation.

II. Dilatation of right auricle.
Ventricular type of the right auricular pulse.
Hypertrophy of the right ventricle.
Venous pulse in the right jugular.
Diagnosis: Tricuspid regurgitation.
(Murmur absent in most marked cases.)

III. Hypertrophy of left ventricle.
Small size of left auricle and arch of aorta.
Prolonged systole.
Palpable thrill.
Diagnosis: Aortic stenosis.

IV. Enlargement of right heart.
Total size of heart decreased.
Heart apparently in middle line.
Right auricular pulse exceeds left auricular.
Diagnosis: Pulmonary stenosis.

Group B, with Diastolic Murmurs.

V. Dilatation of left auricle.
Auricular pulse slow or absent.
Enlargement of right heart.
Palpable thrill.
Diagnosis: Mitral stenosis.

VI. Dilatation of right auricle.
Right auricular pulse slow or absent.
Left auricular pulse slow or absent.
Left auricle small.
Diagnosis: Tricuspid stenosis.

VII. Great enlargement of left ventricle.
Increased pulsation of aorta.
Normal auricular pulsation.
Corrigan pulse.
Diagnosis: Aortic regurgitation.

VIII. Great enlargement of right ventricle.
Increased pulsation of pulmonary artery.
Small or absent right auricular pulse.
Increased but collapsing left auricular pulse.
Diagnosis: Pulmonary regurgitation.

IX. Marked general cardiac enlargement.
Fixation of heart.
Marked systolic retraction of apex.
Systolic tug of diaphragm.
Ascites (Pick's Disease).
Roentgen-visible bands of adhesions.
Diagnosis: Adherent pericardium.

No symptom complex, however, can tell the story of adherent pericardium, as some cases give neither signs nor symptoms. It is obvious that the possibilities of great variations in the adhesions can cause variation in the roentgen signs. This subject is an excellent one for a roentgenological monograph.

Congenital affections of the heart form another subject which is admirably suited to a roentgenological monograph. Open ductus arteriosus of Botalli, open foramen ovale and other affections of either the auricular or ventricular septum, conditions arising from pulmonary stenosis, stenosis of the aorta and other abnormalities deserve careful investigation for roentgenological signs.

Certain rare conditions may be recognized by the roentgenologist without special study. Such are aneurism of a heart chamber and calcifying pericarditis.

The cardiac arrhythmias have become the most interesting lines of heart study. Some day we will have perfect kinematographic representations of heart movements, so that, for example, a case of heartblock may be studied in slow and repeated detail. At present, however, the fluoroscopic screen is the true moving picture screen of clinical diagnosis.

In a case of extrasystoles we have a premature contraction of the left ventricle

before filling is complete. There is then a lengthened filling period with a stronger beat following. Sometimes the premature beat is not sufficiently strong to open the aortic valve. The beat can not then be felt at the wrist. The finger on the pulse and the stethoscope over the apex beat will infallibly detect extrasystoles. However, this irregularity is the best one by which the roentgenologist may train his eyes, because it involves a single heart chamber only as a rule and is the most common of all cardiac irregularities.

In auricular fibrillation we have an extreme irregularity of the auricular and ventricular beats. There is utter loss of synchronism. But the fibrillation is strictly auricular. The moment the ventricle fibrillates, death is immediate. The fibrillating auricle remains in continued diastole and the auricular distention is usually extreme. The auricle formerly was thought to be paralyzed, but the electrocardiogram shows that the auricular muscle is the seat of delirious activity. Minute contractions are incessant. The ventricular type of the auricular pulse is present with a part of the ventricular systoles, showing that the ventricle contracts some of the time without complete closure of the tricuspid valve.

On the fluorescent screen the minute auricular contractions can not be seen. But the ventricular type of the auricular movement in conjunction with the absolute irregularity of the ventricle and the marked distention of the auricle, give us reliable roentgenological signs of auricular fibrillation.

Symptom Complex X.
Extreme distention of right auricle.
Absolute ventricular irregularity.
Intermittent ventricular form of auricular pulse.
Diagnosis: Auricular fibrillation.

Auricular flutter is one of the newest forms of cardiac irregularity to be recognized. It is virtually a form of heartblock with extremely rapid auricular pulsations which are not all transmitted to the ventricles. Thus we find all the conditions of classical heartblock with a very rapid instead of a very slow rate. Two-to-one-block is the rule but if the block be four-to-one, as is occasionally the case, then the pulse may beat at a normal rate. Complete heartblock brings the pulse to 30 or thereabout, leaving the auricle beating at an average rate of 200 a minute. When all impulses which accelerate the auricular contractions are transmitted to the ventricles, the condition is indistinguishable from paroxysmal tachycardia.

Under the *x*-ray, it is impossible to follow so rapid a rate with the eye. The roentgenocardiogram would have to be made with the carriage running at 3 or 4 times the usual speed. Each time that the mitral or tricuspid valve opened and the auricular blood were sucked into the ventricle, there would be a collapse of the auricle which would give a wave in the roentgenocardiogram. The flutter of the auricle would be difficult to distinguish.

In ordinary heartblock the auriclo-ventricular muscle bundle of His is impaired so that the impulses from the sinus node which reach the auricle and cause normal contraction, fail to reach the ventricle, either in part or wholly. The ventricle therefore omits beats in a certain ratio to the regular auricular beats, such as 1 to 2 or 1 to 4, etc. In complete heartblock the ventricles are cut off from all connection with the auricles and beat at about 30 to the minute.

What is the appearance of such a heart under the *x*-ray? We have filled auricles, the muscle of whose thin walls was contracting rhythmically to impulses from the sinus node. But such an auricle can as a rule be seen to pulsate on the *x*-ray screen during the dropped beat, because the thin muscle of the right auricle is able to drive the blood back into the venæ cavæ although the left cannot return it to the pulmonary veins to any appreciable extent. It is only when the mitral and tricuspid valves open and the auricles empty into the ventricles that we see on the screen the

collapsing pulse of the auricles. What we do see chiefly is a dilatation of the right auricle without the ventricular form of the auricular pulse. The left auricle does not dilate as much because it never has to deal with as great an increase in blood volume. The blood under arterial tension continues to flow into the right auricle until the tricuspid opens to fill the right ventricle. The roentgenologist who expects to see on the screen a well defined difference between the auricular and the ventricular pulsations may be disappointed because his attention may be fixed on the marked auricular pulse seen on the screen which is due to the collapse of the auricle when the blood is sucked into the ventricle in diastole. The muscular contraction of the auricle itself is sometimes too diffuse or feeble to show on the screen, although it gives a definite line in the electrocardiogram. We have yet to learn the full extent of all that the roentgenocardiogram can reveal in heartblock.

Alternation of the pulse is considered by Lewis to be of the greatest prognostic importance. He says:

"Alternation of the pulse belongs to a small group of phenomena witnessed by those who attend the sick, which, treated as isolated signals, are in themselves emphatic and portentous. It ranks with subsultus tendinum, with optic neuritis, with the risus sardonicus and other ill-omened messengers. It is the faint cry of an anguished and fast failing muscle, which, when it comes, all should strain to hear, for it is not long repeated. A few months, a few years at most, and the end comes."

It is rare that the finger on the pulse is able to perceive this sign. The sphygmograph, the dial form of the blood-pressure manometer, the electrocardiograph, and the roentgenocardiograph are able to detect it. Of these the blood-pressure manometer is the best and most often available. But the eye of the roentgenologist may occasionally note this phenomenon from screen observations of the ventricular systole just as he may run across aneurism which has been overlooked in the physical examination.

The most fundamental and universally recognized part of the roentgenology of the heart is the determination of heart volume. Dr. C. W. Bardeen, dean of the Medical School, Wisconsin University, has sent me at my request a quantity of unpublished data on the anatomy of the heart in the living. These data are based upon a very large number of personal observations and have for their object the following fundamental points, in the words of Dr. Bardeen:

1. To determine the size of the heart in the living;

2. To establish a normal standard with which to compare a given case;

3. To determine the relation to health of deviations from this normal standard.

To obtain the shadow area of the heart Bardeen prefers the teleroentgenographic method. Regarding this method he says:

"Standard distance 2 m. Although this is usually stated to be essentially equivalent to the use of parallel rays it is nevertheless necessary to make allowance for enlargement of the heart shadow due to divergence of rays. The degree of this enlargement depends on the distance of the cardiac margin from the plate. This distance can be determined by stereoscope and varied distance methods and can be checked up with observations on cadavers. The results of various studies show that in an average adult the average distance of the cardiac outline is about 4 cm from the inner surface of the sternum and 6 cm from the surface of the skin in front of the heart. For pictures taken at a distance of 2 meters therefore, with the patient leaning forward against the plate, an allowance must be made for an enlargement of the heart shadow amounting to about six per cent. in area and three per cent. in a given diameter. This has, therefore, been taken as a standard for adults, although the use of this standard may lead to an error of one to two per cent. in individual cases."

Concerning the "calculation of the size of the heart from the *x*-ray shadow," Bardeen summarizes his conclusion in the following words:

"Determination of cardiac volume from cardiac outline. Dissecting room observations. Formula determined .53 area 3/2 power.

"Determination of ratio of volume of cardiac substance to volume of contained blood. Dissecting room observations comparing volume of heart with volume of cardiac muscle. Results give a ratio of about 40% muscle to 60% contents.

"Determination of ratio of weight of heart to weight of body. Recent observations show that the empty heart weighs about 1/200 of the weight of the body at all ages. This is borne out by observations with dissection room material.

"Determination of the volume of heart muscle from the weight of the body based on the formula

$$\frac{.005 \text{ Body Weight}}{1050}$$

"Determination of the ratio of volume of heart muscle thus calculated to the volume of the heart in diastole as determined by the formula .53 area 3/2 power. Ratio found to be about 44.9%. Hence the human heart in diastole is composed of about 55% of blood and 45% of heart substance."

This survey shows that the roentgenology of the heart is developing along clinical lines. The future is seen to hold interesting possibilities. It is likely that this department of our work will acquire a relatively high degree of precision. It is inevitable that the internist will become increasingly dependent on the screen and plate. It is already true that roentgenological methods are necessary to a complete examination of the heart.

ROENTGEN DIAGNOSIS OF BRONCHIECTASIS*

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THAT the roentgen rays furnish more or less definite information in the diagnosis of bronchiectasis has long been recognized; but a review of the literature impresses one with the chaotic state of mind of most observers in regard to the cardinal points on which the roentgen diagnosis is based, and the difference in opinion existing among internists as to its relative value. Most observers agree that the ordinary methods of chest examination—percussion and auscultation—are of questionable value in bronchiectasis, the diagnosis usually being based on the history of cough, profuse expectoration and a proper exercise of the olfactory sense. That a diagnosis based on such data is often erroneous may be easily understood when it is considered that these features are equally essential in the diagnosis of abscess of the lung and chronic bronchitis.

The object of this paper is to emphasize certain facts long known to roentgenologists and to impress on the internist the fact that the roentgen rays furnish us with most valuable information in the diagnosis and differential diagnosis of bronchiectasis.

The relative failure of medical treatment in these cases and the success that has attended surgery, when proper care is exercised in selecting cases for operation, render it essential that all available diagnostic means be employed to determine the nature and extent of the process. The roentgen rays offer in a large percentage of these cases the only means of ascertaining the true nature, extent and location of the affection, such information being abso-

* Read at the Seventeenth Annual Meeting of the American Roentgen Ray Society, Chicago, September 27-30, 1916.

lutely essential in the selection of the course of treatment to be pursued. As has been emphasized by Jackson, the possibility of the presence of a foreign body, even without history, must be considered in all cases of bronchiectasis, thereby adding another reason for routine roentgen examination. The number of these cases that have been diagnosed in the past as tuberculosis, or in which the patients have been subjected to a thoracotomy and drainage operation under the mistaken idea that the condition was either an abscess or an empyema communicating with the bronchi, is sufficient proof of the hazy clinical picture that many of these cases present.

Etiology.—While much has been written concerning the etiology of bronchiectasis, it is probably sufficient to say that any condition which tends to weaken the bronchial walls and lessens their elasticity or increases the pressure within the bronchial tubes, predisposes to this disease. The bronchi and bronchioles are weakened and their resistance is lowered by any bronchial inflammation, either acute or chronic. The inflammatory changes in acute bronchitis and the atrophic changes in the elastic and muscle fibers in the chronic form may lower the resistance of the bronchial tubes sufficiently to render them unable to stand the strain of any increased pressure. These degenerative changes are most common in bronchopneumonia and bronchitis resulting from whooping-cough, measles, influenza and fevers. The etiologic importance of bronchopneumonia in particular can not be too strongly emphasized. Increased pressure in the tubes is usually produced by cough. Cough is probably the most important factor in bronchiectasis, although retention of secretion, such as occurs, for example, when the bronchus is plugged by a foreign body, must also be regarded as of considerable importance. It is highly probable that both foreign bodies and enlarged bronchial lymph glands produce bronchiectasis more by reason of the associated cough than by the local obstruction they produce. Another factor to be considered is traction on the bronchi and bronchioles due to indurative or cirrhotic changes in the lung, such as occur in tuberculosis, syphilis and other infections. The fibrous tissue produced by these changes may contract, causing sufficient traction on the bronchi and bronchioles to produce a subsequent dilatation. However, in view of our present knowledge of this disease, it seems probable that bronchiectasis results more frequently from a combination of these causes than from any one alone. Poor hygienic surroundings apparently exert a marked influence in its production, few cases being found in patients living under conditions of proper hygiene. Although the work of Smith and others has established beyond question the importance of the Bacillus influenzæ in bronchiectasis, in the majority of our cases the infection has been mixed.

Types.—Bronchiectasis may be classified from the standpoint of the roentgenologist as occurring in three types: the infiltrative, the cylindrical and the sacculated. These three forms most probably represent different stages in the disease and demonstrate the existence of gross changes that have been proved by pathologists.

The first or infiltrative type appears in the roentgenogram as a more or less stringy increase in density along the course of the bronchi, usually localized in the lower pulmonary lobes and radiating outward from the hilus to the periphery of the chest and extending into the costophrenic angle. This infiltration in the earlier stages of the disease is not particularly marked and differs little from that seen in chronic bronchitis or other irritative conditions of the bronchial tract, save that the process is usually more localized, is found nearly always at the base of the lung, the bands of increased density extending to the periphery of the chest. It is probable that this stage corresponds to the clinical stage in which drainage is effective and there is relatively little retention of secretion. The infiltrative form of bronchiectasis presents the chief difficulties to the roentgenologist,

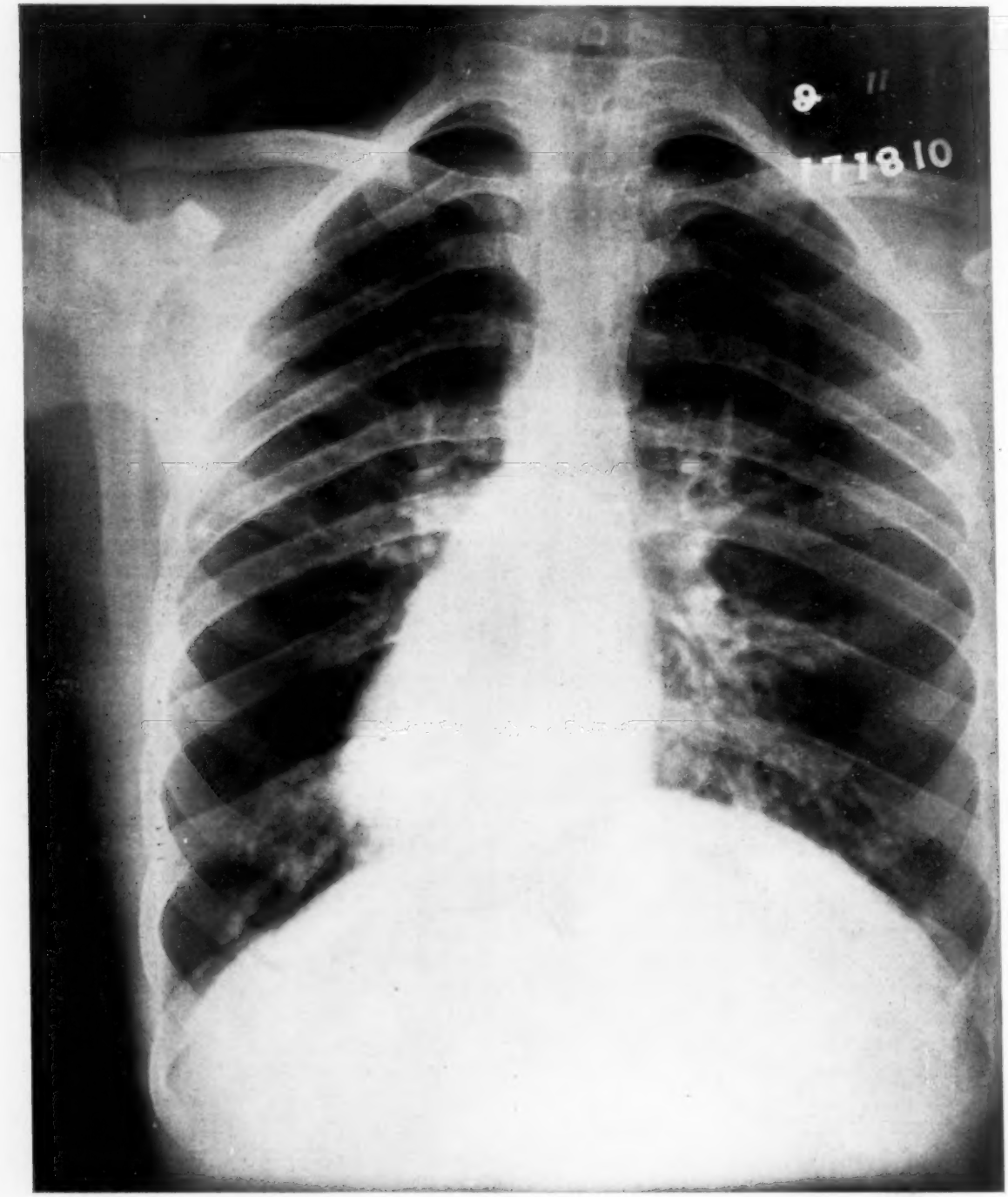

FIG. 1 (171810). BILATERAL INFILTRATIVE BRONCHIECTASIS INVOLVING BOTH LOWER LOBES.

and in many cases it is impossible to make an unqualified diagnosis.

The infiltrative stage is followed by the cylindrical type. There is the characteristic mottled increase in density, extending outward along the course of the bronchi, producing a more or less fan-shaped shadow. The density is usually greatest near

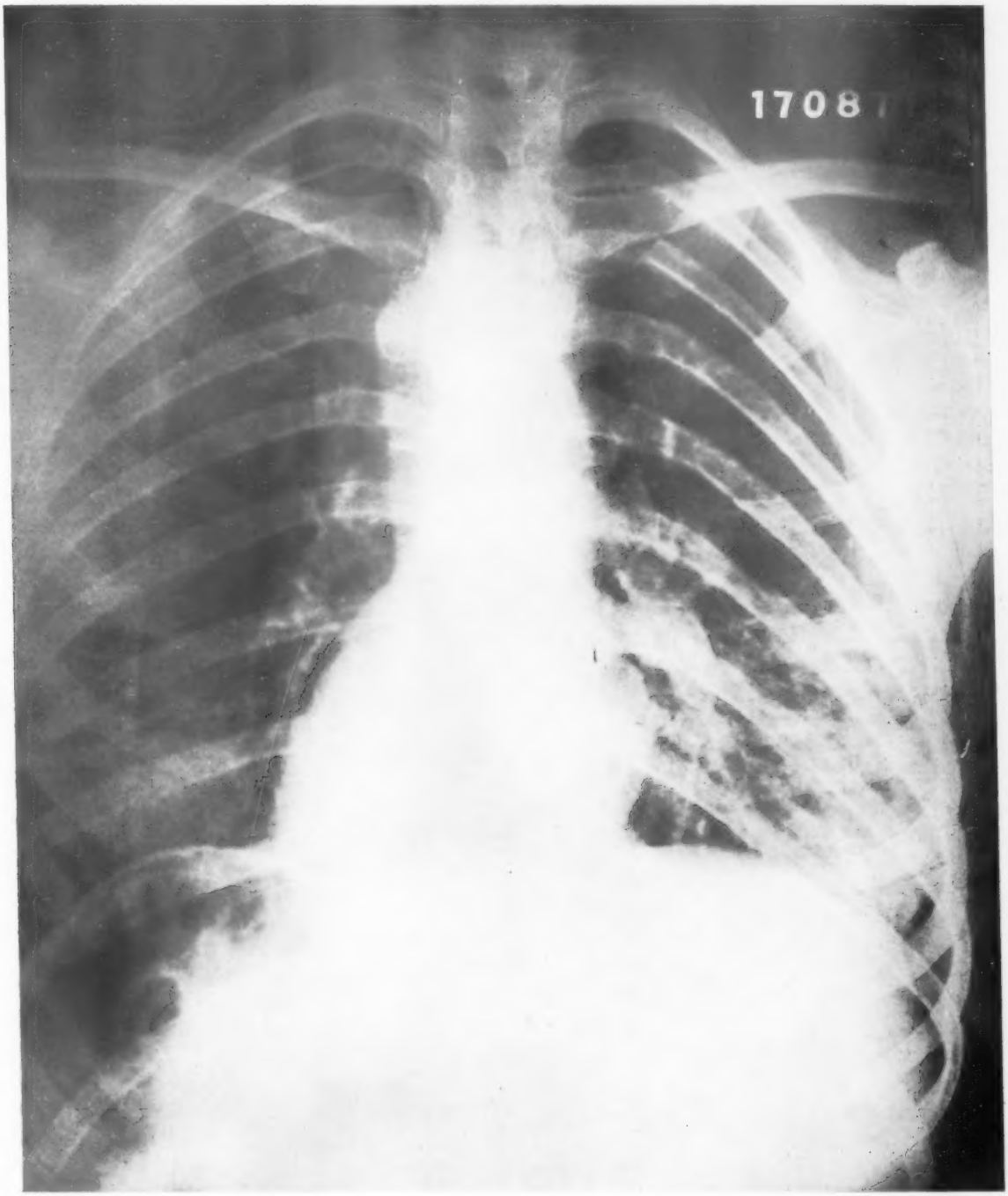

FIG. 2 (170877). UNILATERAL CYLINDRICAL BRONCHIECTASIS INVOLVING THE MIDDLE AND LOWER RIGHT PULMONARY LOBES.

the hilus and, distributed throughout this density, one or more small areas of diminished density may be located. These areas are more or less clearly circumscribed and are produced by the so-called pseudocavitations of bronchiectasis which are dilated bronchioles that have been emptied of their secretions. The visualization of

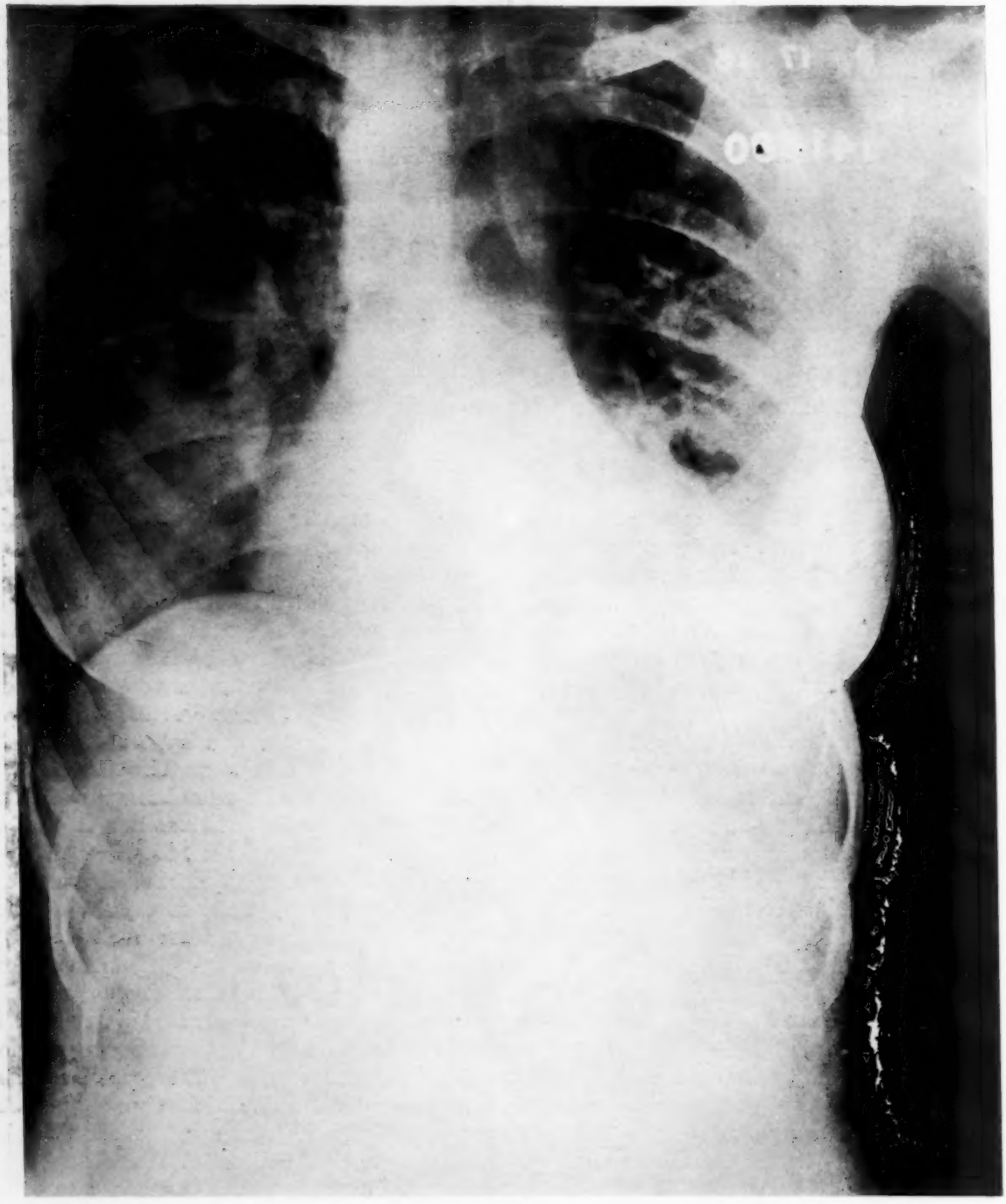

FIG. 3 (141430). UNILATERAL CYLINDRICAL BRONCHIECTASIS INVOLVING THE MIDDLE AND LOWER LOBES OF THE RIGHT LUNG.

these cavitations depends largely on the ability of the patient to empty the bronchi of secretion, and their presence is pathognomonic of the disease. Consequently, a doubtful diagnosis is often made certain by a second roentgen examination after the patient has brought up as much of the bronchial secretions as possible. This is

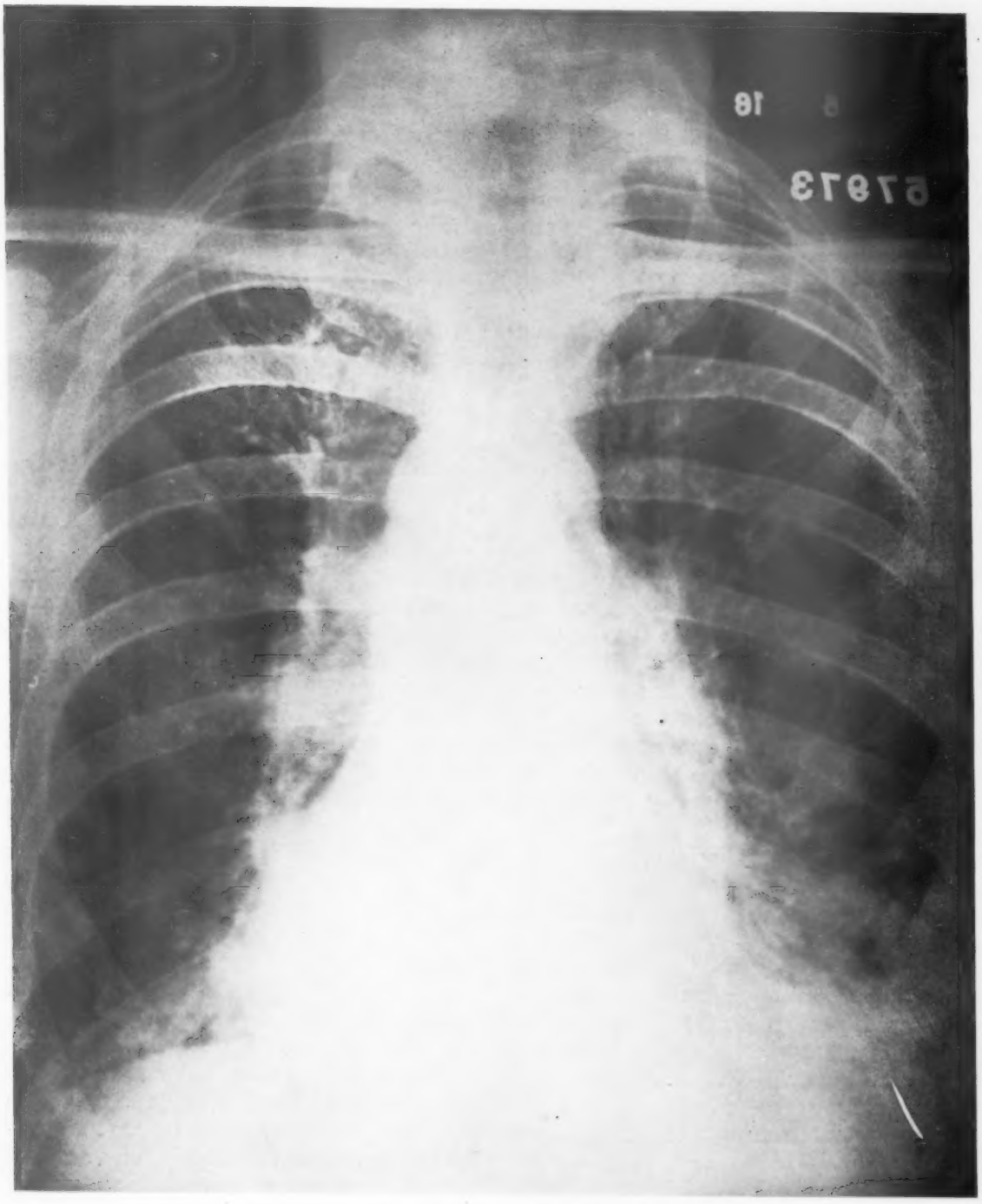

FIG. 4 (57973). VACUOLAR BRONCHIECTASIS OF RIGHT LUNG.
Note large sac in middle lobe. Healed tuberculosis of upper left lobe.

most easily accomplished by instructing the patient to cough while in the Trendelenburg position, face down. It is the fan-shaped increase in density along the course of the bronchi and the localization of one or more of these pseudo-cavitations that make the roentgen diagnosis of the cylindrical type of bronchiectasis practically

certain. However, should the process be confined to that portion of the left lung which is hidden by the superimposed heart shadow, a diagnosis may be impossible. The possibility of the existence of such a condition should therefore always be borne in mind before an unqualified negative diagnosis is given in a case that is clinically suspicious.

The third or sacculated type of bronchiectasis is characterized roentgenographically by the localization of distinct pseudo-cavitations surrounded by dense fibrous tissue. These cavitations are practically always multiple and larger than those encountered in the cylindrical type. They vary in size from that of a bean to that of a walnut and have a thin wall. The section of a lung involved by the sacculated type of bronchiectasis very strongly resembles a bunch of grapes cut through the center. The fibrous tissue surrounding these groups of sacculations is very dense and often feels like cartilage. It may be so dense and the cavitations may be so filled with secretion that the shadow in the roentgenogram is almost homogeneous and the diagnosis difficult. However, the true condition is usually revealed by emptying the cavities.

Thickening of the pleura, either parietal or visceral, is rather uncommon in bronchiectasis except in those cases in which a previous thoracotomy has been performed, and it is only in such cases that any marked distortion or limitation in the movement of the diaphragm is seen. However, in cases of long standing, particularly those of the sacculated type, the heart and mediastinal structures are often drawn to the affected side by the contraction of fibrous tissue.

Differential Diagnosis.—The more common conditions from which bronchiectasis must be differentiated roentgenographically, are chronic purulent bronchitis and lung abscess.

It may be differentiated from chronic bronchitis by the greater increase in density along the bronchial trunks in bronchiectasis, the tendency to localize at the bases of the lungs, the extension of this increased density to the periphery of the chest even as far as the costophrenic angle, and the presence of bronchiectatic pseudo-cavitation or sacculation. Bronchiectasis is usually differentiated without difficulty from abscess of the lung by its location and the fact that the walls of its cavity are relatively thin and small. The cavities are multiple and there is absence of a fluid level within them.

This report is based on a series of twenty-five cases that have been studied by combined clinical and roentgenographic methods, the findings of which have been tabulated.

The average age of the patients was 26½ years, the oldest being 48 and the youngest 10 years; 14 were males and 11 females. The average time since the symptoms were first noted was 8 years. In all but 7 the onset of the disease was described as a cough following an acute infection, commonly measles, whooping-cough and influenza. The other diseases noted in order of frequency were scarlet fever, pneumonia and tonsillitis. It seems almost certain that a very large percentage of these cases have their origin in the bronchopneumonia which is so frequent a complication of these diseases and which contributes so ideally to the production of bronchiectasis. The chief complaint in all of these cases was cough and expectoration. The cough is described as being at first dry, hacking, and unproductive, gradually increasing in severity, tending to become paroxysmal, and gradually more productive. The sputum is at first like that of bronchitis, consisting of clear mucus. As the disease progresses, the sputum becomes more profuse and more foul, until it may amount to several quarts a day. In appearance, these patients are poorly nourished, anemic and toxic, with a more or less constant clubbing of the fingers. Nine of the patients in our series had some elevation of temperature when examined, and all gave a history of attacks of chills, fever and sweats. While such attacks are usually

associated by the patients with "taking cold," it seems most probable that they represent a localized bronchopneumonia with congestion and retention of the secretions. The fact that the degree of intoxication from the large amount of putrid material present is not greater is probably due not only to the relative immunity acquired but also to the comparatively slight absorption that takes place from the walls of the pseudo-cavitations. Seven of the patients gave a history of definite hemoptysis and twelve of an occasional tinge of blood in the sputum. Two patients had inhaled foreign bodies; a splinter of wood in one case which was subsequently coughed up, and in the other a fragment of tooth which plugged one of the terminal bronchi, as was found at autopsy. Five patients gave roentgenologic evidences of a tuberculous infection and three had tubercle bacilli in their sputum. A definite roentgen diagnosis of bronchiectasis was made in nineteen and a diagnosis of probable bronchiectasis in two. In four the roentgen diagnosis was incorrect. The errors in this series occurred in the diagnosis of cases of the infiltrative type in which the condition was confused with bronchitis.

Roentgenographically these cases were classified as follows: Infiltrated 8, cylindrical 12, sacculated 5. In fourteen cases the condition was bilateral; in eleven cases where the involvement was unilateral, six were located on the right and five on the left side. In the cases in which the process was confined to one lung, it involved more than one lobe in all but four. This clearly illustrates the small percentage of cases that are at present diagnosed at a sufficiently early stage to permit of radical surgical interference and the great value of a roentgen examination in determining the extent of the process and the operability of a case.[1]

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[1] The discussion on Dr. Moore's paper will be published in another issue in connection with the papers of Drs. Dunham, Miller, Stewart and Van Zwaluwenburg.

THE CAPILLARY CIRCULATION IN THE ROENTGENOGRAM OF THE CHEST*

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IN our efforts to interpret thoracic roentgenograms in terms of the pathological changes represented, we are constantly limited by our ignorance of the significance and the relative importance of the shadows we see. This is in part due to the lack of opportunity to confirm our opinion, because few of our cases come to autopsy and these have suffered considerable change, many of the factors involved being modified or disappearing before the subject reaches the prosector's table. Terminal complications of an infectious or circulatory nature often produce grave changes in the pathological picture. This being particularly true of circulatory changes, we have comparatively little information concerning the roentgenographic importance of the blood supply of the lungs.

That the influence of this factor may be greater than is generally appreciated is suggested by an observation that was made in connection with the roentgenographic examination of four cases of spontaneous pneumothorax that have come to my service in the last three years.

One of these cases was seen in two attacks, the first involving one side of the thorax and the other, after the lapse of about a year, the other side. In the routine description of these plates, it was noted on both occasions that, contrary to expectation and precept, the partially collapsed lung was relatively less dense than the opposite normal lung. A roentgenogram that had been taken in the interval showed the normal symmetry of the two sides, thus definitely disposing of the argument that some other pathology was responsible for this observation. Moreover, no other pathology was ever found in either lung by any method. Obviously, the reduction in the density of the lung could only occur through reduction in the mass of the lung and its contents, and this reduction was not only a reduction of the total mass but of the mass per unit area as well. The only shadow-producing portion of the lung that could conceivably escape from the field of observation are the fluids, and particularly the blood.

The vascularity of the lung is probably not sufficiently appreciated. Physiologists estimate that the average blood volume of the two lungs is not far from 1,500 c.c. The pathologist rarely sees a completely exsanguinated lung. I am assured, however, that its weight will scarcely exceed 250 grams. In other words, 750 grams of blood occupy the vessels of an organ weighing 250 grams, representing 75% of the total weight, and by inference, 75% of the density of the lung is due to its blood content. We know that a part at least of the so-called "bronchovascular" shadow is due to the contents of the large blood vessels, but it takes but a cursory glance at a good normal chest plate to assure one that but a very small fraction of these 750 c.c. is so represented. The remainder is therefore represented only by the general opacity that forms the background upon which the more striking picture of the "bronchovascular tree" is spread.

Certain confirmatory facts will occur to the mind of every one experienced in this line of roentgenography. The familiar picture of the variable density of the chest in cardiac cases, depending on the nature of the lesion and the degree of compensation, is evidently due to the presence or

* Read at the Seventeenth Annual Meeting of the American Roentgen Ray Society, Chicago, September 27–30, 1916.

absence of pulmonary congestion, and it is a noteworthy fact that any increased density is most marked in that part of the lung traversed which has the greatest thickness, namely, along the diaphragm and the spine in the paravertebral region. Perhaps you have seen tuberculous shadows of considerable size disappear and leave what at first sight seems an inadequately small scar. Is it not possible that much of these shadows represent merely the hyperemia of the inflammatory area which disappears without the formation of scar tissue? A friction rub is sometimes represented on the plate only by a slight unilateral opacity along the rib line; may this not be due to the hyperemia of the lung just below the inflamed pleura?

The experimental demonstration of changes in the blood content of the lung really involves two distinct problems, namely, the production of such changes of blood volume and their demonstration in the roentgenogram. Until recently, the latter problem offered insuperable difficulties which, however, have been lessened with the advent of the Coolidge tube. All that is needed is an accurate reproduction of a given exposure, both in quality and quantity of the roentgen rays, and the simultaneous treatment of the resulting plates in the same bath.

The essentials for the successful reproduction of the exposures in the order of their importance are:

(1) A reliable Coolidge tube loaded well within its capacity;

(2) storage battery control;

(3) a steady potential on the power lines;

(4) a reliable automatic timing device.

Our greatest difficulty lay in the third factor. Although the voltage of the University lines is regulated to within one per cent, another load has recently been added to the circuit of our service transformer, causing a decided drop in the voltage which is easily recognized on the voltmeter, and making it necessary to station a special watchman at that instrument and to select a time when no other load falls on the circuit. All plates failing to meet this condition must naturally be discarded.

Another annoying source of error results from the slight drop in potential in the battery circuit with long continued use. It became a condition, therefore, that the whole experiment must be concluded within the shortest possible time.

As a precaution, a marker was usually included which produced a pattern on the plate that could easily be compared with that on its mate. All sets that did not rigidly check as to the density and contrast in its image were also discarded.

EFFECT OF INTRATRACHEAL PRESSURE

As a preliminary to the later experiments, the influence of deep respiration on the density of the lungs was first investigated. Plates were made in deep inspiration, followed by deep expiration. Being familiar with the importance attached by the earlier fluoroscopists to the absence of increased brightness of one apex on inspiration as a sign of early tuberculosis, we were prepared to find a marked difference in density. This is, however, by no means constant in degree. In many individuals the difference is little greater than would be expected from the greater area over which the density of the lungs and thoracic parietes are spread and can almost be eliminated by increasing the focal plate distance, thus avoiding excessive distortion. In other individuals the difference is striking.

The cause for this variation is not at all clear. It is evident, however, that comparable plates must be made in the same respiratory phase. In the remainder of the experiments, the experiment was completed with a closed glottis, or a tape was passed around the chest and lungs filled to correspond to the same degree of tension on the tape.

A comparison between the density under normal intratracheal tension and under the conditions of the "Valsalva" experiment

established no constant demonstrable difference, one set of plates showing a scarcely appreciable reduction in density.

"Mueller's experiment," consisting in forced inspiratory effort against a closed glottis, produces a diminished intratracheal pressure. Physiologists recognize several phases in the circulatory changes produced by this maneuver. The primary effect is on the heart, causing an accumulation of blood in all chambers and a dilatation of the great vessels of the pulmonary circulation. The ultimate effect leads to a failure of the radial pulse, presumably from interference with the contraction of the right auricle. Variations in the effects depending on the vigor of the effort may therefore be expected.

This experiment was compared with the normal as well as with the "Valsalva" conditions and the results were not found to be altogether uniform. The changes in the size and shape of the heart, the increase in the broncho-vascular tree, both in extent and caliber, were easily and constantly produced. An undoubted increase in the general opacity of the lungs could be demonstrated in only a few of the sets.

Our experiments do not offer a satisfactory explanation of these differences. If the effect is purely mechanical, one would expect the increase in density to vary with the vigor of the effort and the time the effort is sustained. Such, however, is not the case. Our most striking result was obtained by first practicing the "Valsalva" experiment, followed by breathing until the respiratory balance was restored, and finally making the Mueller effort. This introduces the undesirable element of longer time, but special care was taken to keep the tube in the same physical condition by heating the target before the first exposure and relighting the tube filament at a definite interval before the second exposure was made.

It is, therefore, altogether probable that other factors (probably neurovascular) affect the blood supply of the lungs under these conditions.

Other experiments were begun, including the effects of drugs and exercise, but the technical difficulties increased so rapidly with the increased load on our service transformer that they have been postponed until this condition could be rectified. On the whole we believe that we have demonstrated that the capillary blood volume in the lung is an appreciable factor in the density of that organ and deserves serious consideration in the study of chest roentgenograms.

The diagnostic application of this principle is made difficult by the relative as well as the individual variations in the distribution of the lung density. In general and bilateral conditions the judgment is particularly difficult since symmetrical portions of the lung fields can not be directly compared and the general illumination of the plate must be depended upon. The greatest thickness of the lung traversed by the rays lies along the diaphragm and paravertebral border just outside of the hilus shadows. In the average chest the density of the whole field is nearly uniform. With an increase in the relative density of the lung, due to an increased blood supply, one would expect to find these areas relatively denser than the more peripheral portions of the lungs, while in a serious reduction of the blood mass the contrary effect of an abnormal hyperradiability of these areas may be expected. Such changes are actually found. The greatest density of the chest in the presence of passive congestion as a result of cardiac disease is found in exactly those regions and may lead to an erroneous diagnosis of edema when no physical or clinical evidence of this condition can be discovered. The effect in the anemias depends largely on the total blood mass. Not all anemias are associated with a reduction of the total blood volume; in fact, most of them consist largely, if not altogether, in a reduction of the hemoglobin and the cellular elements. In such cases, one might conceive of a compensatory increase in the pulmonary blood volume to

allow of more perfect reaction of the attenuated medium. Such speculation leads us far beyond the known facts and "gets us nowhere." But in the cachexias of malignancy and tuberculosis, in the disturbances of fluid intake or excretion such as pyloric obstruction, diarrhea, and the polyuria of diabetes, a marked hyperradiability of the lung in this territory may be looked for and will be found in a surprisingly large proportion of cases.

Local changes in the capillary circulation can be more easily and more certainly recognized by an asymmetry in density. No doubt they are an important factor in the shadows of local infections, such as pneumonia, abscess, empyema or tuberculosis. The local hyper-radiability of senile and hypertrophic emphysema is probably due to the disappearance of the capillaries in the walls of the air vesicles rather than to the greater amount of air in the locally inflated portion of the lung. So, too, the localized greater density of the lungs in the presence of mediastinal masses may with greater probability be ascribed to obstructed return circulation or involvement of the neurovascular mechanism than to obturation atelectasis, as has been done in the past. As a matter of fact, a foreign body that from its size and position must have produced such an atelectasis according to our observations produced no increased density in the territory supplied by that bronchus.

The greater radiability of the partially collapsed lung in pneumothorax is an example of a local reduction in density of the lung shadow and is a matter of considerable interest to roentgenologists inasmuch as it makes the diagnosis more difficult. The density of the lung is in some instances so little greater than that of the air-filled pleural cavity that a distinction can only be perceived with the greatest difficulty. The greater mobility of the visceral pleura by reason of the lost support of the chest wall tends to obliterate its sharp line of demarcation, and, with a slight degree of collapse, this line falls in that portion of the chest where the parietes are thickest and the scapular border confuses. The result is that the condition is easily overlooked, and but for the insistence of the internist I should have failed to recognize two of the five instances of this condition that came to my laboratory. In one case I was unable to demonstrate it, until the exposure was made in the expiratory position. Since then, this technic has always been employed with more satisfactory results. By the further collapse of the lung in this position the density is increased, the margin is more nearly fixed and brought into a position where it is seen more easily and in sharper relief. We would recommend a trial of this procedure in doubtful cases.[1]

[1] The discussion of Dr. Van Zwaluwenburg's paper will be published in another issue in connection with the papers of Drs. Dunham, Miller, Moore and Stewart.

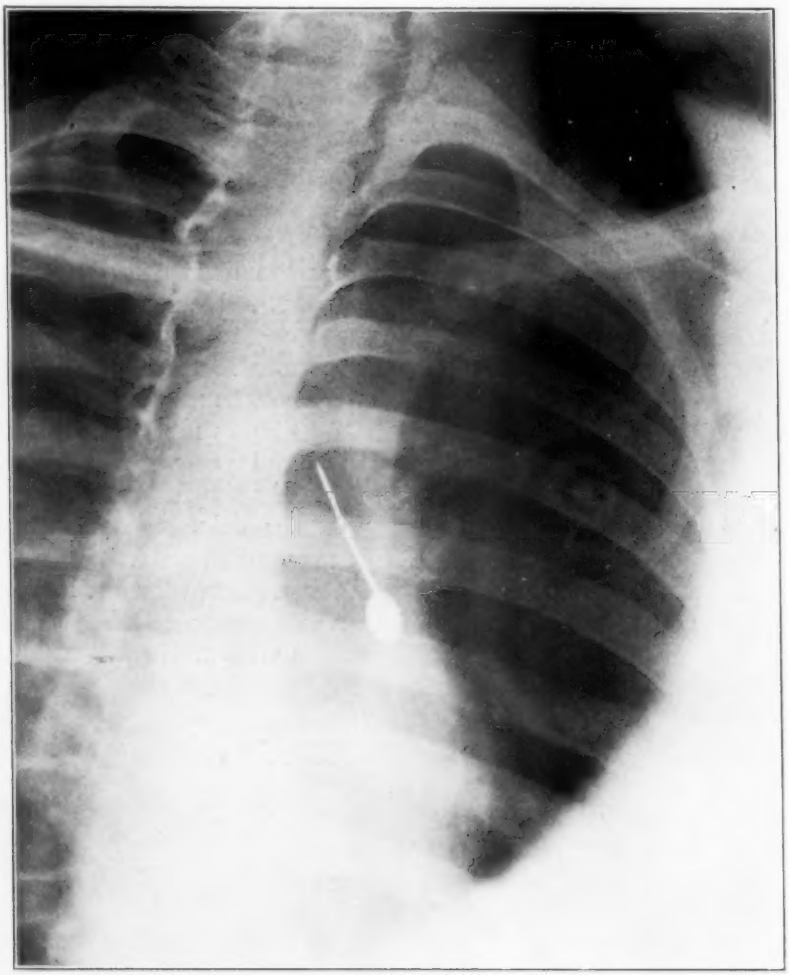
SCARF PIN IN THE RIGHT LUNG

BY P. M. HICKEY, M.D.

DETROIT, MICH.

PATIENT, eighteen years of age, while holding his scarf pin in his mouth during the process of tying his cravat, was seized with a fit of coughing, and the pin disappeared down his throat. The patient was of the opinion that it had passed down into his stomach and paid but little attention to the accident for a couple of days, when he consulted his physician, who suggested that he have an *x*-ray examination.

Examination with the fluoroscope showed the pin to be located on a level with the bifurcation of the trachea. A plate was made in a slightly oblique position so that the shadow of the pin was distinct from that of the vertebræ. The shield of the pin was wedged in the right bronchus, while the pin projected into the trachea.



SCARF PIN IN RIGHT BRONCHUS.

The patient presented no distinctive symptoms of a foreign body, there being

present no cough and no irritation on forced coughing.

Under ether anesthesia, the bronchoscope was passed and the point of the pin was found to be free in the trachea. The bronchoscope was threaded over the pin, the forceps inserted and the pin removed. Recovery was speedy and uneventful.

The interesting points in this case are, first, the comparatively large size of the foreign body inspired, and, second, the entire absence of subjective symptoms.

AN INTERESTING CASE OF ARTERIOSCLEROSIS

BY R. C. MAHANEY, M.D.

OWOSSO, MICH.

THE patient, Mr. J. C., American, age 68, single, hard-working farmer, gave a negative history except for being a very free partaker of alcoholic drinks. He had never been sick. The family history was negative, except that the father also was a heavy drinker. History of syphilis was denied. Examination of the heart, lungs and kidneys showed normal findings. Systolic blood pressure 125.

The patient first consulted me in May, 1915. He complained of a genital sore of nearly three years' standing, which had gradually increased in size until the glans and foreskin were practically destroyed, a foul odor being present. A diagnosis of carcinoma was made and a radical operation performed at once. The wound healed nicely without recurrence, up to the time of his death, which occurred a year later. In February, 1916, the patient complained of weakness which became more and more noticeable until he succumbed in April, 1916. No post mortem study was obtained.

The accompanying roentgenogram shows the femoral vessels with most startling clearness. The radial arteries also showed marked sclerosis.

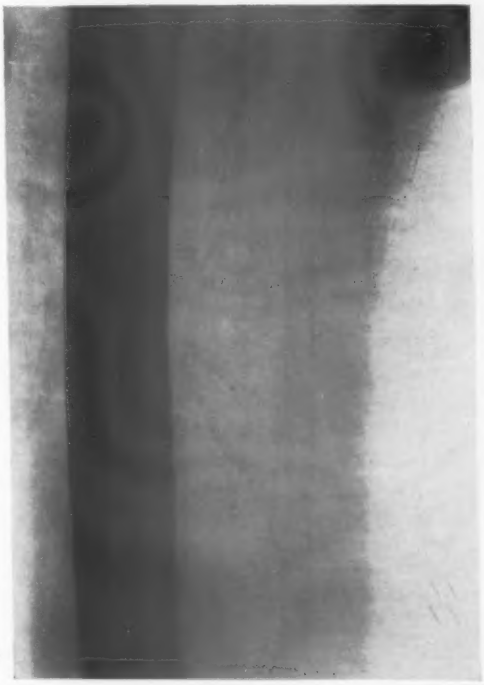


FIG 1. ROENTGENOGRAM OF THE THIGH, SHOWING MOST UNUSUAL CALCIFICATION OF THE FEMORAL VESSELS.

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EDITORIALS

ROENTGENOLOGICAL PREPAREDNESS

Preparedness is in the air, military, social, industrial, everywhere, look where you list. Military preparedness includes efficiency of the medical department, and medico-surgical efficiency is not complete at the present time without roentgenological aid. Have roentgenologists given the necessary thought to the part they are logically expected to take at the supreme moment should the state of preparedness of this country be put to the test?

Mr. Hughes opined in his recent Kansas City speech that this country can not be got into war without most inexcusable blunders. Assuming that to be true, for the sake of argument, would it not be an equally inexcusable blunder for roentgenologists to stand by idly in the hope of no primary blunder occurring—in the face of the fact that even Americans are human and therefore liable to err? Clearly the entire nation bears the responsibility of being prepared for emergencies in private as well as in national life, and the roentgenological section should live up to its duty in bearing its legitimate share of it.

In the *Engineering Magazine* for September, H. L. Gantt comments that "without efficiency in management, efficiency of the workman is useless even if it is possible to get it." That is the roentgenological case in a nutshell. While fully admitting that roentgenology is still a young science, the practical application of a newly developed scientific device or invention need not and does not at the present time require the deliberate slowness of evolution with which our ancestors were compelled to reckon. The fact, which will probably not be disputed, of our being unable to place at the disposal of the government a full and adequate equipment of roentgen service for immediate use in field and base hospitals is explained by that spirit of indifference toward potential possibilities which has distinguished American placidity on more than one epochal occasion. The embalmed meat scandal of the Spanish-American war still lingers in the nostrils of a shocked nation, and the fact that during that war, which was a mere opera-bouffe as compared to the gigantic proportions of the present conflagration, dozens of vigorous soldiers succumbed to preventable

disease to every one that died a legitimate death from the bullets of the enemy, is a sad reminder of American medical unpreparedness in times of war. In the Russo-Japanese war, conditions were precisely reversed on the Japanese side, typhoid being practically unknown, beri-beri a negligible quantity, and wounds yielding to antiseptic treatment—not on the battlefield in the midst of a dust- and germ-laden atmosphere, but in properly equipped flying field hospitals which followed the army in the thick of the fray and established themselves in protected locations. The character of the Japanese has frequently been held up as largely imitatory, but in the matter of medical preparedness in a great war they were the first nation to completely reverse the relative figures of death from bullets to death from preventable disease.

The achievements of modern roentgenology make it incumbent upon us to hold our service ready for emergencies. The European war has been instrumental in evolving many new ways in which the power of the roentgen ray can be utilized, and there is not a single number of the few foreign medical journals that reach our shores at present but contains descriptions of roentgenological diagnosis and treatment in the various theaters of war. The methods newly devised to rapidly and reliably locate the position of bullets and other foreign bodies are too numerous and devious to be more than casually referred to in an article which is not intended to do more than call attention to their extreme importance, necessity and usefulness in times of war, aside from ordinary considerations.

Captain A. Howard Pirie, of the Canadian General Hospital No. 3, stated in the March number of the *Archives of Radiology and Electrotherapy* that the first thing done in connection with the x-ray department was a visit to New York, where a special equipment was purchased to be sent to the front. The fact of the department having selected an American installation proves that America knows, to that extent at least, what is needed and is able to supply it. European countries, however, have gone considerably farther. Among other ingenious devices they have combined the automobile with a dynamo in such a way that a complete roentgen equipment may be mounted and operated on the machine which furnishes from its own motive power the electricity for the roentgen current. Every phase of a roentgen examination may be carried out inside the car, or any part of the installation may be dismounted and carried into a neighboring house, barn or shed, the current being supplied by a connecting cable from the dynamo in the car. An especially serviceable car of this description has been constructed under the direction of Professor L. Bauer, a leading consulting internist in the Eastern field of war, and Dr. F. Haenisch, whose distinction as a leading roentgenologist need not be dwelt upon in these pages. The efficiency of this installation is said to be fully equal to that of a small, first-class, modern roentgen institute, the necessary apparatus and instruments being specially modeled in such a way as to adapt themselves to the congested room conditions of the car.

Just as every new mutilating and killing device is followed by counter-inventions to frustrate it, so it is the duty of the medical fraternity in general and of the roentgenologist in particular, to minimize and salve the horrors wrought by swords and bullets. If the war has brought forth "terrestrial superdreadnoughts" to inflict the greatest possible havoc upon the anatomy of the enemy, similar "tanks" in the shape of roentgen automobiles should be in operation to make good as far as possible what the former have committed. The roentgenologist, too, has to assume his duties of humanity in times of war and to work hand in hand with the medico-surgical department to assuage the unmitigated horrors wrought in the name of civilization.

According to Secretary Daniels' communication to the press in August "prob-

ably the best way to understand the true significance of the three-year shipbuilding program authorized is to state that its construction, together with the other ships authorized under Wilson's administration, will cost $655,255,806." In the face of such figures, which are a mere trifle as compared to the cost of actual war, would it be out of the way to ask and work for an appropriation of a paltry million for the establishment and maintenance of an efficient field roentgen service, to enable us to place the powerful aid of the roentgen ray at the disposal of the maimed and injured? But, as quoted at the beginning of this article, "without efficiency in management, efficiency of the workman is useless even if it is possible to get it." Just as little as a senatorial paper resolution to increase the numerical strength of the army will avail anything unless recruits flock to the colors, just as little will any sum of money locate a single bullet in a soldier's chest, unless the roentgenological fraternity rallies to the colors, making up its minds to bear its share of the duties devolving upon the nation to supply the necessary service.

There is no longer any question as to whether it can be done. Europe has shown that it can be done and how it can be done, but it is idle to suppose that a trained staff of roentgenologists can be produced at a moment's notice to go to the front or that the necessary roentgen equipment with automobiles and other paraphernalia can be furnished in an equally short time, unless competent measures are taken in times of peace to be prepared for war. Have roentgenologists given the necessary thought to that part they are logically expected to take at the supreme moment when the state of preparedness of the country shall be put to the test?

Criticisms Regarding Roentgenotherapy

At the Clinical Congress of Surgeons of North America which recently convened at Philadelphia, it was easy to perceive that the present attitude of the surgical profession is strongly influenced by a powerful wave of criticism of roentgen rays and radium as therapeutic agents in cancer. Some of this criticism is unkind and unjustifiable, the result of failure to distinguish between the claims made by overenthusiasts and propagandists, and the good results demonstrated by the relatively few men who are in a position to know whether the application of the roentgen rays or radium has been carried out with proper technic and adequate dosage.

As a rule, the treatment is wholly inadequate. There are in this country literally hundreds of roentgen equipments presided over by men and women not prepared by education or experience to use them. Very often the one in charge is not even a physician. Even though a physician, it does not follow that, being given charge of a roentgen installation he is thereby endowed with the necessary knowledge and experience to use it. And even the physician trained in diagnostic roentgen work may be woefully deficient in the therapeutic application of the ray.

Much confusion and skepticism has been generated by the extravagant claims of some whose opportunities outstripped their knowledge of the physical laws governing the therapeutic use of radiant energy; but on the other hand the records of conservative competent men should command respectful consideration, and before deciding as to the extravagance of the claims of the radiologists, referring both to roentgen ray and radium therapists, one should be sure he understands just what they have shown themselves able to accomplish.

The sincere radiologist has no axe to grind. His heart is not set on the fulfillment of hopes for the success of a particular method. He aspires to be considered a scientist, not a propagandist. His greatest interest lies in contributing his share in the battle against disease, and though he may be disappointed over his failure to do the impossible by curing malignancy already beyond surgical relief, there is still

the gratifying realization that his labors have relieved pain and lengthened the span of useful life in these unfortunate cases. In the words of an ancient English surgeon, "if a panegyric were necessary, it were best made by running through the particulars of the art and the history of the diseases relieved thereby." And though failing in absolute cure of malignancy, we still will appreciate the palliative good effects of radiotherapy, which are far better than can be obtained for these cases in any other way.

Telling The Whole Truth

The editor has recently had occasion to search through the very voluminous literature on roentgenotherapy in the treatment of deep-seated malignant disease.

There are in the literature numerous reports of rather remarkable cures which have resulted from the application of the ray. In the majority of instances the report of cure is made within a year or two of the time treatment was instituted. Naturally, in a perusal of these reports, some of which have been in print more than two years, the reviewer was curious to know the present state of health of the various patients reported as being cured of deep-seated malignancies. Accordingly personal communications were addressed to the authors of these several reports asking them for a note as to the present state of the patient. In the majority of cases the report came back that the patient had later developed a recurrence of the malignancy and died. It is needless to say that the final results were disappointing, especially in view of the rather lively hope inspired by the tone of the articles as they originally appeared in the literature.

The lesson taught is obvious. The same publication in which the original report of an apparent cure of malignancy appeared should, by all means, present a later report correcting the first impression, should events turn out otherwise than one would be led to expect by the first report. Of course this applies not only to roentgenological work, but to all branches of medical and surgical activity. It applies especially, however, to those roentgenologists who are seeking more recognition by their medical and surgical collaborators.

An Alleged Invention

The wiseacres in all ages have raised their voices to discredit every advance made in science or the arts by their more enterprising fellows. They have denounced with fiendish delight both the petty charlatan and the great discoverer. Occasionally their anvil chorus has been rudely interrupted by the practical realization of some seemingly incredible achievement, such as the telephone, the wireless telegraph and the *x*-ray.

Such achievements warn us to exercise caution and a reasonable restraint in discussing such an invention as that which is described in the *British Medical Journal* of September 30, 1916, under the title, "The Delineation of Internal Organs by an Electrical Method." The name of the author of this article is not given, but the inventor or discoverer is said to be "James Shearer, aged 30, at present a sergeant in the Royal Medical Corps working at a casualty clearing station."

The article states that the new invention "appears to succeed just where *x*-ray photography fails, or rather it takes up the task of producing pictures of structures hidden far below the surface of the body just at the point where *x*-ray photography ceases to perform it effectively. . . . The new work attempts the delineation not of dense structures such as bone, but of living soft organs, such as the liver, the kidneys, and the intestines."

About the merits of the alleged invention we have no information. The statements in the article mentioned can hardly be classed as information. We mention the subject here merely because it has been given wide publicity through the near medical columns of such newspapers as

the New York *Times*, which have quoted the *British Medical Journal*.

The verbiage of this pseudo-scientific article and the description of some of the mysterious forces employed remind us of the writings of the late lamented Keeley, who for twenty-five years experimented with a motor at the expense of the public. We are told, for example, that "the process interposes between two alternating electric fields of equal strength—and at the precise point where they meet—a third electric field, whose facultative potential force is thus released and can be converted into dynamic power. It is this released circuit which operates the recording needle and the pattern tapped out on the revolving cylinder varies with the shape of the organ furnishing that circuit."

A little later we read that "every organ in the body constitutes and originates a separate electric field, and that the facultative dynamic power of this field, as also its shape, varies precisely with the constitution and shape of each organ in question."

The reader naturally wonders whether this wonderful facultative dynamic power is obtained from something that is poured out of a bottle or something that is smoked in a pipe. If this question had been cleared up in the beginning, it is likely that the article would not have appeared in the *British Medical Journal*, and would not have been mentioned in hundreds of alleged news items throughout the world.

Among other statements which we think might have been investigated by some one on the editorial staff of the *British Medical Journal* is the following: "*The rate of alternations in the currents, and therefore the force of each electrical impulsive, must be varied according to the rate of vibration of the tissue molecules.*" We think also that some one on the editorial staff of this journal should have inquired of the author of the article why Fig. 2 shows lines alleged to be due to blood-vessels of the brain, but no blood-vessels in the neighboring tissues. It is strange also that some one did not compare this spook diagram of blood-vessels of the brain with those furnished by well-known anatomists.

We suppose that the editor was willing to print Figs. 1, 4, and 5, showing respectively kidney, intestine and liver without blood-vessels, on the supposition that the machine was not warmed up to blood heat when these were made. The author of the article has plainly stated: "So far as it has at present been developed, it never delineates more than one type of tissue on the same occasion, and the speed required for some tissues has not yet been learnt."

Statements such as these we have quoted, together with the decidedly queer illustrations accompanying them, make us wish that our highly esteemed contemporary, the *British Medical Journal*, had not sanctioned the publication of this story, which should be interesting chiefly to those who like fairy tales and who believe in ghosts.

Having thus displayed great caution and restraint in the treatment of this article, we wish to say again that as to the merits of the alleged invention we have no reliable information. The object sought, *i. e.*, the delineation of internal organs, has been dreamed about and predicted since long before the discovery of *x*-rays. We hope that it may some day be accomplished. Every honest and intelligent effort toward the solution of this problem deserves not ridicule but sympathy and encouragement. There is, however, no encouragement to honest and intelligent endeavor in the publication by a reputable medical journal of such an article as we have quoted.

E. W. CALDWELL.

TRANSLATIONS & ABSTRACTS

LENK, ROBERT: Roentgen Findings in Fresh Abdominal Bullet Injuries. (*Muench. med. Wchnsch.*, Aug. 29, 1916, p. 1278.)

The author, who is a military surgeon with the Order of the Maltese Knights, at present in the Isonzo Section at the Eastern front, has found that one of the most important questions to decide in connection with the necessity of operations in fresh abdominal bullet wounds is whether or not there is a perforation of the intestine. As clinical symptoms are not always decisive, any additional help in clearing up the conditions is desirable.

A roentgen examination in these conditions has been found likely to afford considerable aid. When a bullet has been arrested in the abdomen, the roentgenogram may indicate its position. In the hepatic region, for instance, or at a place free from intestines, a roentgenogram may decide the indication to operation. In shots in the back, the roentgen rays will often disclose with considerable positiveness whether the projectile has remained in a retroperitoneal position. This can often not be established clinically.

In cases where a bullet has passed through the abdomen, a roentgen examination in the sitting posture may show an intestinal perforation, if present. The author has frequently seen in such cases the picture of a multiple stenosis of the small intestine consisting in abundant gas bubbles in the intestine, often superimposed over a horizontal layer of fluid. This collection of gas is evidently due to the intestinal injury or to peritoneal irritation of paretic intestinal loops. It has indeed often been observed that the injured intestinal loops are those to be paralyzed. The fact, however, that the gas escaping from the intestine can be seen on the screen, is of greater importance. This occurs almost exclusively in shot injuries of the large intestine. There is an abnormal ("subphrenic") gas bubble between the right diaphragm and the liver in the shape of a light, narrow, semilunar strip above the hepatic border. This can be mistaken only for an upward displacement of the liver by the transverse colon, but this would be a rare case and besides could be recognized by the haustral formations.

A subphrenic gas abscess does not occur in fresh bullet wounds and, besides, can be easily distinguished from a subphrenic gas bubble. In the former, there is a distinctly vacillating fluid below the gas; in the latter, there is instead the hepatic contour running parallel to the diaphragm. In a subphrenic gas abscess, the diaphragm is fixed either absolutely or to a large extent, while in the presence of a simple gas bubble it is normally movable. Two sketches will explain the conditions.

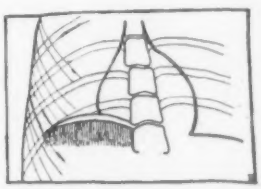

FIG. 1. SUBPHRENIC GAS BUBBLE.

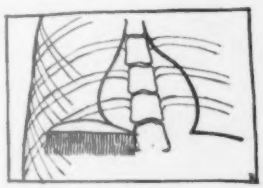

FIG. 2. SUBPHRENIC GAS ABSCESS.

According to the author's experience this symptom is a sure sign of injury to the colon or stomach. In times of peace, it will be found valuable in differentiating between perforated gastric ulcer and perforated appendix or gall bladder.

The last two symptoms, however, can be observed only in the vertical posture.

The author adds that hematoma may also be roentgenologically demonstrated in the peritoneal cavity. The diagnosis of a hemorrhage of the spleen may be of importance. He has often succeeded in recognizing the latter condition in the form of an extensive, moderately dense shadow, changing with respiration, in the left hypochondrium. These findings, too, may be important for surgical indications.

SCHWARZ, G.: Silverbromide Papers as a Substitute for Roentgen Plates. (*Wiener kl. Wchnsch.*, 1916, No. 29. Ref. *Muench. med. Wchnsch.*, Aug. 29, 1916, p. 1264.)

Schwarz has made further experiments with different silverbromide papers and comments on the importance of their proper selection and application. The most sensitive papers (such as the roentgen paper of the N. P. G., Berlin) should be used principally in exposures without an intensifying screen (extremities; Benoist V; 6 Wehnelt; exposures one-quarter

longer than with plates). The less sensitive papers (as for instance, the Parabrom Cartons of Prof. Laimer, Vienna, or the silverbromide paper of Dr. Byk, Berlin) should be used only with the intensifying screen. The pictures are obtained with relatively short exposures and are of great beauty (Benoist VI or over VI; 8 Wehnelt).

The papers should be inserted in a cassette which compresses them absolutely flat and in such a way that the roentgen rays pass from the reverse to the active side of the paper and then proceed through the film side of the intensifying screen.

At the present time, these papers are much cheaper than plates, and can be suitably employed

(a) for survey roentgenograms of bandaged limbs;

(b) for shot injuries of the extremities;

(c) for the control of healing processes;

(d) for heart exposures;

(e) for coarse examinations of the lungs and pleura;

(f) for exposures of the stomach and intestine.

The bromide papers can not be used

(a) in suspected affections of the bones and joints where the greatest accuracy is required;

(b) in affections of the cranium and the spinal cord;

(c) in the most delicate examinations of the lungs (as for instance in incipient tuberculosis);

(d) in renal exposures.

It would be advisable to establish a central test institute for roentgen papers and plates in order to ensure the reliability of the supplies.

STEWART, WM. H.: Gumma of the Ulna. Congenital Syphilis. (*Am. Atlas Stereoroentgenol.*, June, 1916, Vol. I, No. 2, p. 58.)

This patient, a male of twenty-three, was evidently suffering from congenital syphilis.

There was a marked swelling in the upper part of the right forearm, attended by pain resembling the pain of toothache, more severe at night. Wassermann + + + +.

The roentgenogram revealed a marked periosteal "rising" surrounding the lower two-thirds of the shaft of the ulna. In the lower half on the inner side appeared an excavation, the crest of which corresponded to the height of the raised periosteum.

A diagnosis of the periosteal gumma was made and a specific treatment has resulted in gradual improvement, with reduction of tumor and diminution of pain.

CASE, J. T.: Thinning of the Cranial Bones in a Case of Extensive Cirsoid Neuroma. (*Am. Atlas Stereoroentgenol.*, June, 1916, Vol. I, No. 2, p. 54.)

This is a most unusual case of a tumor on the right side of the face, involving the right cheek and the right supra-orbital region. The patient thought he was born in this condition.

All the tissues of the right side of the face were very much infiltrated and thickened. During the last eight or nine years there had been a progressive enlargement of the growth.

The stereoroentgenogram revealed no asymmetry of the skull or malar bones, but both maxillae on the right side were deformed by pressure of the tumor. The stereo further showed several well-defined areas of decreased opacity of the cranial bones on the right side of the skull.

The operable portion of the tumor was removed surgically and the roentgen ray was employed as a therapeutic measure, in order to dispel the remnants of the tumor. Case concludes that the x-ray treatment had no effect upon the tumor.

Pathological examination of the tissues showed that the greater part of this tumor was a cirsoid neuroma.

SELBY, J. H.: Hair Pin Free in Urethra Fifteen Years. (*Am. Atlas Stereoroentgenol.*, June, 1916, Vol. I, No. 2, p. 46.)

This article is illustrated by a very pretty stereoroentgenogram showing the pin in relation to the urinary tract.

The inguinal regions, the scrotum and perineum were dusted over with bismuth powder. The stereo shows a metal hair pin two and one-half inches long, situated in the urethra, the points toward the meatus, and three and one-half inches from it. There was no evidence of incrustation, rust or erosion.

The patient confessed that at the age of nine, fifteen years before, he had inserted this hair pin by its blunt end.

BARRET, G.: Localization of a Projectile Free and Mobile in the Right Ventricle. (*Jour. de Radiologie*, Jan., 1916, Vol. II, No. 1, p. 37.)

The localization of this foreign body was accomplished under exceptionally peculiar conditions. The foreign body presented an unusual and incessant mobility. The displacement which it exhibited with each cardiac impulse occurred with such amplitude and rapidity that only by the most searching screen examination could one perceive the ball even for a short instant.

In this case the localization outlined by Hirtz, or any similar method, would have been very difficult of application because of the movement of the projectile.

A screen examination showed that the projectile was included in the cardio-pericardial mass, near its anterior border, a short distance above its lower border, its average position corresponding almost to the right edge of the sternum.

There was also an effusion toward the right, crowding the heart toward the left, and signs of pericardial distention.

One naturally concludes that the foreign body is free in the cavity and that this cavity is distended by an effusion.

LEDOUX-LEBARD: Shrapnel Ball Free in the Right Auricle. (*Jour. de Radiologie*, Jan., 1916, Vol. II, No. 1, p. 35.)

Even in war times reports of such cases are sufficiently rare to warrant their publication, when accompanied by roentgenograms.

In order to make a roentgenogram showing the ball, it is necessary to obtain practically an instantaneous exposure (at least one-twentieth of a second). Finzi has reported a case in which an exposure of one-tenth of a second was satisfactory, but in this instance the ball was in the wall of the heart and not free in its cavity.

JAGUEAS, F.: A Case of Diverticulum of the Esophagus. (*Jour. de Radiologie*, Jan., 1916, Vol. II, No. 1, p. 39.)

The author reports a case of diverticulum of the esophagus in a woman of forty-five.

A curious thing about her case was the fact that she sometimes rejected small particles of food eaten several days before, the food being always of a certain character, such as rice, for example. Otherwise there was no particular difficulty in swallowing.

At the roentgen examination a barium (milk) preparation swallowed in small quantities passed into the stomach without incident. On a second test the patient was asked to swallow the barium in large gulps, after which there appeared in the cervical region a shadow coming off from the esophagus, possessing regular lines and with lower border well-rounded. These particles, complemented by the persistence of the shadow, as well as its appearance in the lateral and anterior positions, made sure the diagnosis of diverticulum.

SKINNER, E. H.: Deep Roentgen Therapy in Unfavorable Surgical Situations. (*Tex. State Med. Jour.*, Feb., 1916, Vol. XI, No. 10, p. 525.)

Skinner gives an important summary of the effect of deep roentgen therapy in massive, measured, filtered doses, and contrasts the effect of such doses with the fractional x-ray exposures formerly given.

Attention is called to the effect of large doses upon the patient's strength and recuperative capacity. It may have such effect that the patient becomes toxic. Particularly is this true in attacking large glandular tumors, where the internal secretions are disturbed, and in inoperable cancerous conditions with ulcerated areas.

Following is a catalogue of situations where the roentgen ray may be expected to achieve results:

Hemangiomas and lymphangiomas especially involving the face and lower lip; leukemia and splenic anemia; Hodgkin's disease; hyperplasia of the thymus in patients up to twenty years of age; prostatic hyperplasia; tuberculous adenitis; enlarged thymus; uterine fibroids; pelvic malignancy; mammary carcinoma; post-operative treatment.

The author insists upon beginning the post-operative treatment at the earliest possible moment. Under ordinary circumstances there is no reason to delay the commencement of the treatment more than two or three days after the operation.

BOND, GEO. D.: The Treatment of Deep-Seated Cancer by the Roentgen Method. (*Tex. State Med. Jour.*, Feb., 1916, Vol. XI, No. 10, p. 527.)

This is a statement of the present screen roentgen treatment of deep-seated carcinoma as judged by letters addressed to twenty leading x-ray workers of this country.

The author presents the statements of these various workers and urges that there should be more publicity given the idea that roentgen treatment is an aid to surgery in the treatment of cancer.

FAULHABER: Diagnosis and Treatment of Chronic Ulcer of the Pylorus. (*Muenchen. med. Wchnschr.*, April 29 and May 6, 1916, Vol. LX, Nos. 17 and 18.)

It is not sufficient merely to make a diagnosis of gastric ulcer. The location of the ulcer is of equal importance. The clinical signs which help to locate ulcer are very uncertain. Neither do the roentgenograms contribute much to topical diagnosis of ulcer.

Riedel attributes gastric pain on the right side to pyloric ulcer; on the left side to ulcer of the lesser curvature. He found pain in the mid-line itself in prepyloric ulcers of the anterior wall, at the posterior wall and in pancreatic adhesions. Clairmont believes, on the ground of operative findings, that the lapse of time after meals when pain occurs is of importance. When pain occurred during meals, the ulcer was found near the cardia; with pain half an hour after meals the ulcer was in the middle of the stomach, and when it occurred at some later time, the ulcer was in the pyloric region.

These statements are only of moderate value so far as diagnosis of the seat of the ulcers is concerned. Clairmont's statements are not confirmed by the author's material. Faulhaber has found by no means infrequently that penetrating ulcers of the pars media caused pain as late as two hours after meals.

This unsatisfactory state of things has undergone an improvement during the last two or three years by the roentgenological symptom complex of callous and penetrating ulcers which was discovered by Reiche, Haudek and the author (Faulhaber). It fulfills for the first time the above demand: positive demonstration of the ulceration and clear localization. But the possibility of their demonstration applies only to a small number of all ulcer cases, not to simple ulcers, but only to those which have already led to complications. Even so, it is a distinct gain to be able to single out some cases for operation.

So far as the vast majority of other gastric ulcers are concerned, the roentgenological hopes have proved deceptive, and a topical diagnosis is impossible, with the exception of one localization—that in the pyloric region. A number of diagnostic signs that point to the pyloric region have been established by several authors, but none of them is positive. The only one that is of real importance in the author's opinion is temporary stagnation. But it is clear that a coarse symptom of this kind will only be found in a small number of cases of pyloric ulcer, and if one must wait for that sign to occur, the great majority of pyloric ulcers will pass unrecognized.

The object of this article is to show that, even without this coarse symptom, we are able to make a topical diagnosis of pyloric ulcer in nearly all cases with tolerable certainty. From a careful comparative study of his cases and a number of operations, the author has recognized the fact that pyloric ulcer may be segregated from the rest of gastric ulcers by a sharply delineated complex of chiefly objective symptoms. Close observation of this symptom complex has taught him to make a correct diagnosis even in cases of atypical subjective symptoms, as confirmed by operation.

Various authors attach different meanings to the expression "pylorospasm." Although at the present time peristolic and peristaltic atony are sharply distinguished, such is not the case with spastic contraction of the pylorus itself and the periodical tonic contraction of the pyloric part of the stomach. This accounts for the divergent statements of etiology, symptomatology and frequency of this condition. It is only the tonic contractions of the pyloric part that causes a tumor which, under favorable circumstances, is temporarily palpable, and it is to those only that the communications of the surgeons refer (Schnitzler, Jonnesco, Manasse and others). The term pylorospasm should not be applied to them. The affection is a rare one.

Pylorospasm, in the proper sense of the term, as it is here used, can, of course, not be palpated, but only recognized by its sequelæ, as in the case of cardiospasm. These manifestations must be seen in the first place in regard to the

evacuation of the stomach, because clinically a somewhat persistent pylorospasm when the pylorus is open much less often than normally, cannot be indifferent to motility.

It was Kussmaul who introduced the conception of spasm of the pylorus into pathology. It forms a necessary postulate in cases where, in a clinically fully developed pyloric stenosis, the pylorus does not appear anatomically stenosed, or not sufficiently so, to fully explain the grave signs of retention. Although Struempell declares this assertion to be not proven, and although nobody has perceived with his senses a pyloric spasm in vivo, the majority of authors do not entertain any doubt as to the occurrence of spastic pyloric stenosis.

Pylorospasm does not necessarily lead to spastic pyloric stenosis. According to intensity, it may lead to any degree of motor insufficiency, from simple retarded evacuation to the gravest stagnation.

A purely clinical diagnosis of pylorospasm, however, is impossible when it causes insufficiency of the first degree, because we are definitely to exclude the frequent motor insufficiency due to myasthenia and other conditions. It is here that the roentgen method steps in as the saving factor, which the author was one of the first to point out. It was in 1911 that he established the axiom: "Motor insufficiency (even of the first degree) is characterized by pylorospasm (or, more broadly speaking, by a pyloric obstacle), if normal peristalsis can be roentgenologically demonstrated; and the diagnosis is safer still when the peristalsis is abnormally active or deepened."

With the roentgenological motility test after Haudek's method, even the lighter degrees of motor insufficiency due to pylorospasm can be positively recognized. The author entirely agrees with Haudek that large six-hour remnants, up to one-half of the Rieder meal, point with certainty to an obstacle at the pylorus, consisting either in spasm or an organic stenosis. This is really a matter of course, because in these cases stagnation is always demonstrated clinically. The decision in favor of spasm has to be made clinically in accordance with the rules given above.

Smaller six-hour remnants, corresponding clinically to motor insufficiency of the first degree, signify pylorospasm only when at least normal, but preferably unusually intense peristalsis can be demonstrated. It also admits of an immediate differential diagnosis as against motor insufficiency due to atony, because normal or exaggerated peristalsis is little compatible with the assumption of primary muscular weakness of the stomach and above all things it must also have the effect of normal evacuation.

The syndrome of a small six-hour remnant with normal or exaggerated peristalsis is pathognomonic for pylorospasm of a light degree. But Faulhaber goes farther and asserts that in most cases it proves the presence of an ulcer or a lesion of the mucosa of the pylorus itself or in its immediate neighborhood.

There is not the slightest doubt therefore that a considerable arrest of motility may occur in callous and penetrating ulcer of the pars media. But, contrary to Haudek's statement, it is not very frequent and is found only in very grave pathologic anatomical changes due to the ulcer (large penetrations, severe perigastritis, large serous tumors) and assuredly is not due to pylorospasm, as a pylorospasm in the presence of a distant ulcer could only be explained by accompanying hypersecretion or hyperacidity. But in both the author's cases there was normal or subnormal acidity. The retarded expulsion is rather to be explained from purely mechanical reasons. The motility of a stomach which is extensively walled in at the lesser curvature is so much impaired that the difficult evacuation is intelligible. Small callous ulcers do not have any great bearing on the case, and simple ulcers none at all. Stierling recently admitted the mechanical factor for the occurrence of disturbed motility in ulcer of the lesser curvature, although he has not yet quite emancipated himself from Haudek's views. He asks the question whether it would not be possible for a spastic, cicatricial distortion of the pylorus to contribute to a more or less ascending fissure, aside from a pylorospasm due to hyperacidity. High degrees of such distortion would obstruct the passage by slight kinking, and light degrees by interference with the opening mechanism of the pylorus.

The size of the stomach as roentgenologically determined is of no importance whatever for the diagnosis of pyloric ulcer in the majority of cases. There is nothing surprising in the fact that the size of the stomach is not particularly changed in many cases of pyloric ulcer, considering the slight degree of motor insufficiency. The slight dilatation which, usually associated with ptosis and atony, was present

in a number of the other cases, might be attributed to hypomotility if it were not found so frequently in atony under normal conditions of evacuation. Considerable dilatation of the stomach was only present in stagnation.

The form of the stomach, whether Holzknecht, Rieder, ptosis or atony, is of no diagnostic importance.

The abstract of this article undertakes only the subject of diagnosis.

BISSELL, J. B.: Bone Sarcoma Treated by Radium. (*New York Med. Jour.*, July 1, 1916, Vol. CIV, No. 1, p. 3.)

Two cases of spindle-cell sarcoma are cited—one, a patient nineteen years old, which has apparently been cured by radium; the second, a case of subperiosteal sarcoma of the upper third of the left humerus, which apparently has not yet yielded to the radium treatment.

From the author's description of the technic, we judge that the treatment has been given very thoroughly. The containers were applied at equal distance points and remained on about two hours. They were applied close to the skin with three mm. lead screens covered with 0.5 mm. rubber. In a week's time this application was repeated, also two weeks later.

Nothing more was done until the following September, when two similar applications were made, two weeks apart; the patient in the meantime continuing to improve until at this time there was very little difference between the arms. The child's general health was good.

The tumor is still rather marked, although somewhat smaller than when the patient first came to the hospital. Several applications of radium of 150 mgm. each, for twelve or fourteen hours at a time, have not decreased it very much.

ABELL, IRVIN: Giant Ureteral Calculus; Anomalous Development of Genito-Urinary Tract. (*Surg., Gynec. and Obst.*, Vol. XXXIII, No. 1, July, 1916, p. 33.)

The points of interest, aside from the size of the ureteral calculus which measured 7.5 cm. in length and 7 cm. in circumference, in the case cited by Abell, are the presence of bilateral pelvic ureteral calculi; absence of colic indicating ureteral descent; possibilities of intra-ureteral calculus growth on lodged nuclei of renal origin; absence of bladder frequency or pain, with practically normal appearance of mucosa and the fibrolipomatous thickening around the pelvic portion of the right ureter comparable to the induration observed in the fatty capsule of the kidney in calculous disease of long standing.

In the second portion of his interesting communication, Abell describes the case of a well-developed young woman of nineteen years of age who had been married for three years and, on examination following abdominal pain on the left side, turned out to suffer from absence of vagina, uterus, tubes, ovaries, and one kidney, the remaining kidney being located in the bony pelvis. Roentgenography played its part in the elucidation of the conditions, and the article is illustrated by a pyelogram showing kidney in front and to the left of sacrum, with the hilum inward and the convex border outward; a cystogram showing interference by the kidney with the normal rounded outline in distention and a roentgenogram showing the rectum traversing the right side of the pelvis.

ROYCE, C. E.: Sarcoma of the Scapula. (*Surg., Gynec. and Obst.*, Vol. XXIII, No. 1, July, 1916, p. 74.)

The author cites the case of a nineteen-year-old young man, without any previous illness, who had met with an accident to his shoulder several years ago and complained of pain. Fluid aspirated from the tumor of the shoulder showed sarcoma, and Royce suggests the desirability of following the same procedure in all similar cases. The matter is of interest to roentgenologists, inasmuch as a roentgenogram taken of the tumor plainly shows a cavity inside of it which would naturally incite to exploration of its contents.

COTTON, FREDERIC J.: Diagnosis of Periosteal Sarcoma with the X-Ray. (*Boston Med. and Surg. Jour.*, Vol. CLXXIV, No. 26, June 29, 1916, p. 946.)

The author has noticed for several years occasional roentgenograms of periosteal sarcoma which, from his most recent case, he describes as follows: "In case of bone thickening, showing in the x-ray plate a picture of slight cortical erosion only, the presence of light stalactite-like threads of bone, perpendicular to the bone

surface, strongly suggests sarcoma." He wishes to have this picture discussed with a view to finding out whether the affection is sarcoma.

The discussion ought to be very instructive, not only because the matter itself is of considerable importance, but because it will furnish an opportunity of collating the experience of roentgenologists gathered in a period of about ten years, during which the picture has been a well accepted test point in the diagnosis of sarcoma. It is for the latter reason, probably, that Dodd, of the Massachusetts General Hospital, did not put his case on record, as mentioned by the author, but this should be no bar to emphasizing once more an important diagnostic fact which is evidently not yet as well known as it deserves to be.

FOWLER, W. FRANK: The Vermiform Appendix. (*Surg., Gynec. and Obst.*, Vol. XXIII, No. 1, July, 1916, p. 6.)

The literature on the appendix during the past year has been very instructive and, in compiling the most important contributions in all its presented aspects for general digest, Fowler allows roentgenology to come in for its share of honors. Thus, he quotes Eisen as furnishing valuable evidence for the diagnostic importance of roentgenology; Imboden as throwing light on the conditions which may prevent visualization of the appendix; McWilliams as classifying the diagnostic difficulties in cases where local pain and tenderness are mild or absent; Morley as explaining errors in the diagnosis of chronic appendicitis.

The author further undertook to have the following important questions answered:

(1) What is the significance of barium retention in the appendix?

(2) What is the significance of inability to demonstrate the appendix by means of the roentgen ray?

(3) What are the roentgen signs of appendicitis?

Fowler selects the following answers from those received:

From James T. Case: "Barium in the appendix is an abnormal phenomenon. It by no means indicates surgery. If, by accurate palpation of the barium-filled appendix, we are able to determine adhesions, kinking, irregularities of the lumen, poor drainage (two or three days, or longer), then we have surgical indications. The poorer the drainage the greater the danger. Inability to demonstrate the appendix by means of the roentgen ray depends upon: First, obstruction of the lumen by an obliterating appendicitis, by turgescence of the tissues attending a recent inflammation, or kinking or adhesions near the base of the appendix. Second, the appendix may fill, but lie so definitely retrocecal, closely adherent to the cecum, that it can not be seen. Also great local tenderness or rigidity of the abdominal muscles may prevent accurate manipulation. Nevertheless, when the appendix remains filled longer than the cecum, we can demonstrate it. Third, failure to use the fluoroscope. The appendix is only occasionally seen in the ordinary roentgenogram. Not even simple fluoroscopic observations will suffice. One must manipulate with the hands or with the wooden spoon, or both. In acute appendicitis manipulation is unwise, but a barium enema will often identify tenderness on pressure as being over the appendix. I have discovered several cases of left-sided appendicitis in this manner. As to the roentgen signs of appendicitis: A.—In acute appendicitis no signs are needed, except the barium enema, as above noted. B.—The roentgen signs of a chronic condition are: (1) poor drainage; (2) localized tenderness on accurate palpation done under fluorescent screen guidance; (3) kinking; (4) irregularities in the lumen so that the appendix is bulbous at the tip, and especially poorly drained at the tip; (5) associated adhesions to the cecum and terminal ilium; (6) unduly long or unduly large appendix. All these signs need not be present. The diagnosis should not be based upon roentgen findings alone."—(Dated December 9, 1915.)

From G. E. Pfahler: "Barium retained in the appendix after the bowel is entirely empty probably indicates a relaxed or inflamed appendix. Inability to demonstrate the appendix by means of the roentgen rays may mean that the appendix is obliterated or that it is filled with some other material and will not permit the barium to enter it. The roentgen signs of appendicitis are localized tenderness on pressure over the appendix, shadow fixation, angulation, constrictions, local dilatations, adhesions about the cecum, incompetent ileocecal valve, and undue retention."—(Dated December 9, 1915.)

REY, J. J.: An Extreme Case of "Dropped" Transverse Colon in a Young Girl. (*Practitioner*, Vol. XCVII, No. 1.)

Rey cites the case of a tall girl of fifteen, measuring nearly five feet, seven inches, who from early childhood had suffered from bilious and gastric attacks, and constipation.

The urine contained a large quantity of indican.

The transverse colon was unusually long, sagging down not only into the true pelvis but coiling upon itself.

The article is illustrated by fifteen diagrams showing the course of the bismuth from the time of ingestion to the 105th hour following the meal.

The colon is certainly very spastic and the condition is one which we have been accustomed to considering as rectal constipation. This department considers this type of colon fairly common in tall, slender girls, and would lay more stress upon the spasticity and rectal constipation than upon the morphological characteristics of the transverse colon.

The case is unique and well worth reporting.

REYNOLDS, RUSSELL J.: Methods Employed in the X-Ray Department in a Military Hospital. (*Practitioner*, Vol. XCVII, No. 1, July, 1916.)

As medical officer of the x-ray department of a military hospital (presumably "somewhere in France"), Dr. Reynolds describes the use of the roentgen method as confined to the localization of foreign bodies. Among the methods employed the "Telephone Probe" makes interesting reading: "(a) When the shrapnel lies embedded in some thick mass . . . landmarks lost . . . and if a sharp probe is inserted to the required depth and the foreign body hit upon, it becomes an easier matter for the surgeon to extract it." And "(b) When a *small* piece of metal is embedded in the tissue . . . and the muscle is explored by the needle attached to the instrument, the characteristic sound will be heard in the telephone when the metal is touched."

From among the one hundred and one other methods of localizing foreign bodies with the aid of the roentgen ray, Dr. Reynolds has found the following the most useful, according to the conditions found: the method of right-angle planes, the screening method, the calculating method and calculation combined with stereoscopy. The method of "right-angle planes" has the advantage of requiring occasionally only two photographs at right angles. He admits that if the fracture is much comminuted, or compound and comminuted, the aid of stereoscopy should be enlisted. As to the use of the latter alone, he finds that "it can not in any way take the place of accurate localization," but is a valuable adjunct to the calculating method. Calculation is resorted to when the bullet, etc. is located in the chest, abdomen or pelvis, where other methods are seldom applicable. After a screen examination the rays are centered and a mark is placed on the skin over the shadow of the body. Shifting the tube by 3 cm., the first exposure is made; after shifting it the same distance from the mark in the opposite direction, the second exposure is made. This gives a double image on one plate. The depth of the foreign body is then found by measuring the distance between a corresponding point on the two shadows and by applying the following formula:

$$h = \frac{a}{a + b} xH$$

a indicating the foreign body shift, *b* the tube shift, *h* the depth required and *H* the distance of the plate from the anticathode.

In the "screening method" the author places a lead pointer over the shadow of the foreign body located, say, in a limb, when the central ray is vertically below. The skin being marked, "the depth is obtained by placing the pointer on the skin at the side of the limb opposite the shadow of the foreign body and shifting it vertically until the shadows of the foreign body and the pointer move together when the x-ray tube is moved under the part examined."

GAUCHER: Dangers of Radiotherapy. (*Bull. de l'Acad. de Méd.*, Paris, July 11, 1916, Vol. LXXVI, No. 28, p. 17. Ref.: *Jour. Am. Med. Assn.*, Vol. LXVII, p. 706.)

Gaucher has been much disappointed with the effects of roentgen and radium treatment of skin affections and especially of superficial cancer. They do not ward off recurrence, and roentgen ulceration may develop even as long as ten years after the exposures.

In a recent case of the kind a young man had a roentgen ulcer develop on the back of the hand and wrist—the area that had been exposed to the roentgen rays on account of nevus ten years before. Gaucher has seen radiotherapy cure lupus completely, while he has often seen it induce an epitheliomatous transformation of the lupus. Radium is perhaps less dangerous than the roentgen rays, but he knows of several cases of ulceration following radium exposures and leaving deforming scars after the ulceration had healed.

In a quite recent case a man of sixty, with syphilitic sclerous glossitis and gummas of the tongue, had been given radium treatment. The gummas on the dorsum of the tongue ulcerated and soon became transformed into inoperable epitheliomas. He declares that the roentgen rays and radium in the treatment of skin affections, and especially of cutaneous cancer, have not given the anticipated results. They should be used with prudence and only in cases in which other modes of treatment are not applicable or have not given results.

(The abstract editor feels in duty bound to include in this department all such reports as the above, even though it does seem that present-day roentgentherapy of skin lesions is a very different proposition from the therapy of ten years ago, especially in the treatment of malignancies. The therapy of ten years ago utilized rays of relatively low penetration, whereas modern roentgentherapy involves the use of very hard rays.)

DELAVAN, D. BRYSON: Radium in the Treatment of Laryngeal Lesions. (*Tr. Am. Laryngol. Assn.*, 1916. Ref.: *Laryngoscope*, Vol. XXVI, No. 8, p. 1111.)

"Vernal catarrh" has been absolutely cured and patients thus treated have remained cured as long as ten years. Radium here seems a specific.

The selective action of radium on lymphoid growths, such as lymphangioma of the tongue, is emphatically specific.

The treatment by radium of papillomata of the larynx is being attended with ever-increasing success.

Leucoplakia of the tongue is capable of cure by radium, but much judgment and skill are necessary to attain good results in any lesion in the mouth.

Tumors of the larynx of various kinds have been caused to disappear with complete return of the singing voice.

In malignant disease the reports are somewhat conflicting, some observers reporting that the "treatment does not seem to have much effect in arresting the disease," but Dr. Delavan regards it as quite significant that this same report adds "under new methods of application better results may be expected." He reports two cases observed by himself in both of which the interior of the larynx had been invaded probably from an extrinsic focus. Both were inoperable. After exposure to large doses of radium the first effect noticed was the immediate control of the troublesome secretions which lost their fetor and ceased; the areas of ulceration rapidly diminished in extent, and in the less severe of the two cases disappeared, while in the other case they seemed to do so. Infiltrations diminished and became soft, the voice became clearer and deglutition improved so that both patients were able to swallow without pain a largely increased variety of food; digestion became normal, sleep more prolonged and restful, strength steadily increased, and there was an almost normal condition of good spirits. One patient, a physician, was able to resume office practice and operative work for a period of over two months. Both these patients agreed that if the outcome of the disease should be entirely unfavorable, the benefits gained in the relief of suffering and the added comfort afforded would well have repaid them for any inconvenience the radium had caused, whether from burns of the skin or other effects.

A knowledge of the use of radium in general is still in its infancy. The failure to gain uniformly successful results is in all probability due to imperfect knowledge (a) of the methods by which the radiations can be controlled, (b) of the amounts of radium which should be used, (c) of the correct duration of the exposures, and (d) of the proper screening of the rays. It has certainly been proved that radium will destroy a superficially located cancer cell. Granting this, it is by no means impossible that with increased knowledge of its action, and skill in its application, deeply seated cells may be successfully reached and destroyed.

Chevalier Jackson, of Pittsburgh, draws attention to the fact that the location of the larynx so close to the skin surface would seem to render it particularly amenable to treatment by cross-firing with roentgen rays externally in combination with radium within the larynx, though as yet

no reports of extensive experiments in this direction have appeared. Our work, though encouraging, is not yet completed. The great advantage of the combination of roentgen ray with radium therapy elsewhere in malignancy has been reported upon by a number of writers, notably by Dr. Russell H. Boggs (AMERICAN JOURNAL OF ROENTGENOLOGY, February, 1916) who states that while cancer of the tongue and buccal membrane are less influenced by radium than cancer in almost any other situation, yet with the combined radiation excellent results were obtained. The results were better when the treatment was given in divided rather than massive doses, with a view to allowing the normal tissue to recover. In all cases, except epitheliomata on the tongue or in the throat, Dr. Boggs advocates massive doses given as quickly as possible. In epithelioma of the lower lip with the combined radiation he has been able to eradicate malignant disease in the lymphatics more thoroughly than can be accomplished by surgery in the more extensive involvements. He states that it is necessary for the operator to know the relative value of radium and the roentgen rays when combining these two agents. How often both forms of radiation are to be repeated must be determined by the judgment of the radiotherapeutist who "must be also a clinician." It is to be hoped that the combined radiation will be extensively experimented with in inoperable laryngeal cancer. Of course, no one familiar with the marvelous results of those rare cases of cancer of the larynx seen in the stages adapted to thyrotomy would think of advising any other method of treatment; but, unfortunately, nearly all cases have reached the inoperable stage by the time a diagnosis is made. As urged many years ago by Semon, all laryngologists should continually preach the necessity for early diagnosis in all laryngeal growths. It is almost a crime to treat for months without a diagnosis any laryngeal condition that could possibly be malignant.

ZUEBLIN, ERNEST: Radiotherapy in Chronic Arthritis. (*New York Med. Jour.*, Aug. 19, 1916, Vol. CIV, No. 8, p. 355.)

Zueblin cites five cases where the ordinary antirheumatic remedies did not produce the desired therapeutic effects. The clinical experiences in these cases show that radio-active substances, such as mesothorium locally applied to diseased joints, is apt to produce a remarkable change in the subjective and objective symptoms of acute, chronic and deforming arthritis.

Not only is pain relieved by the local application of radiating energy, but also the infiltration of the articular and peri-articular structures becomes less noticeable, and a reduction of the synovial fluid, and a gain in the active and passive motility are noticed. The danger of ankylosis, so frequent a consequence of the acute and chronic forms of rheumatism, resulting from the immobility of the joints engendered by the pain, can and should be overcome by radio-active treatment whenever the ordinary internal medication proves unsatisfactory.

In the course of the past few years the knowledge of the curative effect of highly radio-active substances in acute and chronic joint affections has been increased by various contributions. Although the number of domestic authors is small compared with those found in foreign literature, the therapeutic utility of radium and thorium in these instances can no longer be ignored by the profession. In dealing with a most frequently chronic course of the disease, sequelæ of which remaining unchecked do not add to the fame of therapeutic achievements, it must be the aim to find and adopt new means of reducing these inconveniences.

Admitting that the highly radio-active substances, radium and mesothorium, merit application in rheumatism, it does not seem strange that magnesium sulphate solutions, which can be rendered radio-active, should produce similar therapeutic results. The author believes that between radium, mesothorium, and magnesium sulphate there seems to exist a physical similarity. The difference in physical effect seems to be one of quantity rather than quality. This difference is also expressed in the biological effect, where the rapid and longer lasting effect must be expected from the more radio-active and fresh preparations.

KELLY, HOWARD A.: Some Radium Achievements (*Am. Jour. Surg.*, Vol. XXX, No. 3, March, 1916, p. 73.)

In view of the uncertainty and divided opinions which still prevail in regard to what radium will do and what it will not do, it is gratifying to have the experience of Dr. Kelly, extending as it does over more than 2,000 cases, the more so as the

results of radium treatment at his hands have in the main been favorable.

Although the results are better the earlier the case is seen, the author does not wish to warn against the treatment of advanced cases, as occasionally even one of these may get well. Perhaps the most favorable group of cases are the lymphosarcomata, where great tumor masses have been made to disappear and the lives of patients saved, who were in imminent danger of choking or starving to death from the pressure of their conglomerate neck tumors. Entire relief has been given to 65 per cent. of these cases, most of which were advanced and desperate risks. Kelly believes that surgery is no longer justifiable in this group, for here surgery is at its worst with its practically invariable recurrences, while radium is at its best with its rapid dramatic cures.

Radium, like surgery, cures basal-celled skin epithelioma in over 90 per cent. of the cases when seen early, but radium has the advantage over surgery in regard to avoidance of mutilation and deformity.

When the glands of the neck are involved, they ought to be removed surgically.

All of Kelly's cases of cancer of the tongue have been apparently cured with radium, but they were admittedly early cases. In cancer of the breast, radium is at its best in recurrences, and some remarkable results were achieved in utterly inoperable cases and in large recurrent nodules fixed to the chest wall. Radium does not replace surgery in operable cases of cancer of the breast.

Turning to the gynecological field, the results of radium treatment of fibroid tumors, bleeding uteri and cancer of the neck of the womb are both interesting and important. Kelly finds that the menstruation in the presence of fibrous tumors can be stopped in about every case, the tumor can be stopped in its growth, caused to shrink and disappear. In young women, it is often possible to preserve menstruation. If pressure symptoms are urgent or in the presence of complicating lateral inflammation or ovarian cysts, he advises operation; in all other cases, radium. In the presence of Bright's or heart disease, or diabetes, which would render operation extremely hazardous or impossible, radium is supreme.

One of the greatest boons of radium is the checking of uterine hemorrhage, thus avoiding a radical operation.

As to cancer of the cervix, Kelly reports on a material of 213 cases, treated during the last six years. Fourteen of these were operable and treated only prophylactically with radium after operation. All are alive and well now. The remaining 199 cases were inoperable, primary or recurrent cases. Of these, 53 were clinically cured, 103 markedly improved, and 37 not improved.

Kelly urges the importance of keeping all radiated cancer cases, even though apparently cured, under occasional observation for some years, as a slight relapse is not infrequent and, as a rule, rapidly responds to another radium application.

The physician should be guided by the following rules:

(1) Operate on every operable case, estimated as a good risk.

(2) Radiate from four to six weeks after the operation.

(3) Do not operate on borderline cases, but use radium first, for the disease practically always returns after operation in these cases, while many are curable with radium.

(4) Radiate all the advanced inoperable cases, for many of these too are curable, or can be shrunken down so as to become good risks.

(5) Where there are metastases up into the abdomen, radiation may give great relief and a temporary return to apparent good health, but it will not cure.

The author hopes for a great extension of the therapeutic application of radium, as it may be of as great or even greater value than the roentgen ray.

LEACH: A Symposium on Dental Radiographic Technic. (*Internat. Jour. Orthodontia.* July, 1916, II, No. 7, p. 467.)

The author lays stress on the importance of roentgenograms in dentistry. He deals principally with the technic. The following are the most important points:

I. The operator should have a good working knowledge of dental anatomy, histology, pathology and nomenclature, that he may be able to give an intelligent diagnosis.

II. As comprehensive a history as possible should be obtained which will greatly assist in the final interpretation of the results, as well as aid in placing the films during the examination.

III. Careful attention should be given to the hard and soft palates as to the relative sized height of the vault, and especially in determining to what distal point the patient can tolerate the film without being nauseated.

IV. In order that the shadow of the dental structure may be about normal a distance of from 12 to 16 inches from the target should be used.

V. The placing and holding of the film is important. The film held by the finger of the patient is probably the most convenient and best.

VII. The angle of the ray in relation to the part under observation, together with the plane in which the film is set, accounts for the greatest percentage of failures due to distortion of the shadows. In the lower molar and second bicuspid regions it is easy to place the film in a plane nearly parallel to the long axis of the teeth and to direct the rays so they will penetrate at right angles to both the part and the film, producing a result which is practically normal.

VII. In making observations of the teeth of the upper arch, set the film so that the upper edge is in close contact with the tissues, allowing the opposite edge to stand slightly away from the crowns of the teeth, thus bringing the plane of the film nearly parallel with the teeth in their entire length. This will help in overcoming the elongation or foreshortening of the shadows.

VIII. Sometimes getting the patient interested in holding the film, together with breathing through the nose or holding the breath, will in a psychic way assist in overcoming nausea.

J. R.

SKINNER and DEWEY: A Comparative Study of the Attachment of the Teeth of Lower Animals. (*Internat. Jour. Orthodontia.* July, 1916, II, No. 7, p. 451.)

The authors as the result of their radiographic investigations conclude (1) that the attachment of the tooth is closely related to the use to which the tooth is put and the amount of stress which is brought to bear upon it, (2) that the greater usage to which a tooth is subjected, the firmer will be the formation of the attachment than is found in those teeth which are very seldom used, and (3) that the tooth is supported through the fibers of the peridental membrane in the higher mammals and that the bone is developed on the opposite side to which the tooth is being forced, or, in other words, as is illustrated in the incisors of the rodent, the stress on the lower incisor would displace it downward; but the heavy development of process is on the lingual side. The development of bone, shown below the lower incisor, is intended not so much as a support to the tooth as it is to form the junction or articulation between the two halves of the mandible.

J. R.

BROWN: Report of a Case of Chronic Suppuration of the Antrum—in Which the Radiographic Examination Was Indispensable. (*Internat. Jour. Orthodontia.* July, 1916, II, No. 7, p. 470.)

A woman had had a right upper bicuspid removed six years previous to permit drainage from a chronically infected antrum of 16 years' duration and suffered from an intermittent purulent discharge.

A radiographic examination showed a foreign body in the antrum resembling a tooth, under the superior wall, which on operation proved to be the root of the bicuspid supposed to have been removed. The tooth had been broken off and the dentist in his efforts to extract the root had driven it up into the antrum.

J. R.

HOLZKNECHT, G., LILIENFELD, L. and FORDES, FR.: Roentgenological Tracing of Fistulæ and their Starting Points by a New Filling Device. (*Berl. klin. Wchnschr.*, Vol. 53, No. 16, April 17, 1916, p. 417.)

The frequency of fistulæ in war hospitals and the unsatisfactory result of their tracing has caused the authors to devise an improvement. The roentgenological detection of fistulæ was inaugurated by Beck (Chicago), who injected a liquid bismuth-vaselin emulsion. Aside from the possible harmfulness of this proceeding, the fistulous opening could not be sufficiently closed to prevent loss or return of the fluid after and during injection. Instead of a liquid the authors use small rods of the following composition:

Zirkonoxyd c.p. (Kontrastin)
Butyri cacao āā
Chini adeps lanæ
Xeroformi 5%

The rods are 8 mm. long and have a width of 2 mm. They can be made in any drug store and, when kontrastin is not available, bicarbonate of bismuth may be substituted. But as the mixture of a viscous substance like cocoa butter with watery pus is not ideal, special "Kontrastin-Gelatin Rods" have been put

upon the market by the Polyphos Co., of Munich, in which the fatty vehicle has been replaced by an aqueous one. The first mentioned formula is therefore only used in emergency cases.

A rod is slowly inserted with forceps into the fistula where it melts. A second, third or as many more rods are introduced as is possible without encountering persistent resistance. The molten substance is distributed into all ramifications and crypts under the continuous pressure from the rods behind. The external end of the last rod does not melt on account of the lower temperature prevailing at the opening. But it becomes soft, acting as a tampon which is held in position by a cotton wad and later fixed with adhesive plaster. Roentgenography is now applied in at least two positions. Stereoscopic exposures are of great beauty. The molten mass penetrates even through a fistular hourglass constriction into a retention cavity behind and makes the way absolutely clear for operation. The latter may be still more facilitated by the use of methylene blue or other coloring substance.

BAETJER, F. H. and FRIEDENWALD, J. On the Value of Roentgen Ray Examinations in the Diagnosis of Cancer of the Stomach. (*Bull. Johns Hopkins Hosp.*, Aug., 1916, Vol. XXVII, p. 221.)

The *x*-ray has presented us with an additional method of diagnosis in the study of gastric cancer, and although like other methods of medical diagnosis which are not absolute, it is probably more correct than any of the other means for diagnosis which are common at the present day. Its findings, however, should always be taken in conjunction with the clinical findings before the final diagnosis is made.

In dealing with carcinoma of the stomach we cannot rely upon the size, shape and position of the stomach nor upon the retention of its contents. Determination of the special lesion is dependent upon the study of two conditions, namely, the peristaltic waves of the stomach, and the many irregularities, or filling defects, in the organ itself.

As a matter of classification we may divide the carcinomatous lesions of the stomach into three classes: first, lesions in the cardiac end of the stomach; second, lesions in the body of the stomach not affecting the orifices; third, lesions at the pyloric end of the stomach. In each of the conditions the activity of the stomach is materially affected, but in quite a different manner.

In lesions of the cardiac area of the stomach, the cardiac orifice is almost always affected, and the patient comes for an examination because there is difficulty in deglutition. An examination reveals a stricture of the cardiac orifice, together with a small or large filling defect in the immediate vicinity. The activity of the stomach itself is normal and, unless the lesion is very extensive, there is no interruption in the peristaltic waves.

In lesions in the body of the stomach, one may have an extensive growth, and yet the patient may complain of very few symptoms, inasmuch as the motor activity is not interfered with. As this lesion rarely affects the cardiac or the pyloric orifice, obstructive symptoms are absent, the stomach emptying at the normal rate or perhaps a little more rapidly than normally. The roentgen ray examination of a stomach of this form generally shows that the peristaltic waves are interrupted in their course at the seat of the lesion, inasmuch as the lesion itself is hard and indurated, and does not admit of further peristaltic movements. In addition a persistent filling defect is almost always present. This filling defect is produced by the growth in the stomach wall bulging generally more or less into the lumen of the organ itself, so that it is outlined by the bismuth in the stomach proper and presents the appearance of an indentation.

In the third class of cases, that is, in lesions about the pylorus, the symptoms arise early as a rule and are due to a partial obstruction which quickly attracts the patient's attention to the gastric disorder.

From a roentgenological point of view we classify growths at the pylorus into two forms.

The first, the annular carcinoma, has its origin within the pylorus itself, and, although it may be very small in size, produces symptoms relatively early, as it soon causes a greater or less degree of obstruction.

The second type also has its origin at the pylorus; it is not annular in form, but invasive, most frequently extending along the wall of the stomach, especially the pylorus. Such a growth may, or may not, produce early obstruction.

Unless due care be exercised, one may easily be misled by certain reflex or spastic conditions

of the stomach. It is not uncommon to observe a stomach presenting a persistent filling defect in a definite area continuing over a period of an hour or two, and in a single instance under our observation for 48 hours, due to this condition. In doubtful cases the question of spasm of the stomach can easily be eliminated by the administration of full doses of atropin for one or two days, until the patient is well under its influence. A second examination, made under these conditions, will immediately show that the suspicious area has completely vanished, and that the condition previously observed was due to spasm.

In the differential diagnosis between gastric ulcer and carcinoma, the points to be taken into consideration are as follows:

1. *Peristalsis.*—In carcinoma, unless there is obstruction, there is always hypermotility with rapid evacuation of contents. In ulcer there is always hypermotility, with a spasm of the pylorus and more or less retention of contents.

2. *Position.*—Carcinoma may occur in any part of the stomach. The invasive lesions are more frequently seen on the lesser curvature near the pylorus, and less frequently on the greater curvature. The massive growths are more generally seen on the greater curvature, whereas ulcer is generally observed on the lesser curvature near the pylorus, although it may occur on the greater curvature.

3. *Filling Defect.*—In carcinoma the filling defect is generally surrounded by an invasive area, which, while not appearing on the plate, interferes with motility, producing an apparently large dead area. In ulcer the filling defect is much smaller, and is not so apt to have the immediate peristaltic waves interfered with, although if the inflammatory area be large, there may be also a dead area surrounding the filling defect.

Carcinoma of the pylorus in the earliest stage is generally annular and produces a crater-like appearance. In ulcer of the pylorus there is a filling defect, but it does not generally assume the crater-like appearance.

Since we have taken up the positive phases of gastric cancer, it is well to draw some conclusion regarding the negative findings. If the fact can be established that there is an absence of all morphological defects in the wall of the stomach; that the peristalsis of this organ is normal; and that there is no tendency even to a partial obstruction, carcinoma of the stomach can usually be ruled out. This is an exceedingly important procedure, as a negative finding is of quite as much importance as a positive one.

LANE, JOHN W. Preoperative Roentgenological Examination in Cancer of the Breast. (*Boston Med. and Surg. Jour.*, Vol. CLXXV, No. 71, Aug. 17, 1916, p. 232.)

The author begins with the idea that once a cancer of the breast has metastasized to other organs, operation is useless. Early recurrences and early postoperative deaths are due not to the operation *per se*, but to the performance of an otherwise efficient operation upon badly selected and already hopeless cases. Lane therefore advocates roentgenological examination of all patients prior to amputation of the breast with a view to demonstrating metastases in the mediastinum, femur, pelvis, spine and humerus, and in the event of positive findings preventing such cases going to the operating table.

PACKARD, CHARLES. The Effect of Radium Emanations on the Rate of Cell Division. (*Jour. Exper. Zoöl.*, Vol. 21, No. 2, Aug. 20, 1916, p. 199.)

Radium emanations produce different effects on unfertilized or freshly fertilized eggs according to the length of exposure or the amount of radium used. Inasmuch as the results obtained by different observers are directly contradictory in regard to the rate of cleavage, Packard conducted a series of experiments on the fertilized eggs of arbacia, placed in seawater at controlled equal temperatures. One lot was exposed to 50 mg. of pure bromide of radium (23.4 mg. of element) and the control lot was separated by a thick sheet of lead. The result showed that there was no marked change of temperature during the entire experiment from this amount of radium.

A number of other experiments followed, but in reporting the details of the same, Packard confines himself to those typical of a large number.

By a special device the radium tube was held at any desired distance above the eggs without any intervening screen. The amount of acceleration or retardation was estimated by comparing the time elapsing between fertilization

and cleavage in the two lots of eggs under examination at a time. Thus, if the radiated eggs began to divide in fifty minutes, and the control eggs in sixty, the difference of ten minutes would be about sixteen per cent. of the sixty minutes.

Exposures were made during five periods of cell activity:

(1) Between 5 and 25 minutes after insemination, when the germ nuclei are approaching each other;

(2) During the prophases, which occur from about 25 to 35 minutes after insemination;

(3) During the metaphase which appears in about 35 to 50 minutes;

(4) During the telophases (50 to 65 minutes after insemination);

(5) During the resting stages following the first cleavage.

The limits of time varied with the temperature of the air, and the distance between the radium and the eggs was varied in each experiment from ⅜ to 2¼ inches.

In the end, the author arrived at the following conclusions:

Arbacia eggs exposed to a brief but intense radiation during the period when the germ nuclei are approaching each other are accelerated in their rate of cell division. Less intense radiation produces less acceleration.

Exposures made during the prophase result in an acceleration unless they are prolonged, when a retardation ensues.

During the metaphase the same phenomena appear, but to a greater degree.

During the telophase the effects are much the same as in the prophase.

Eggs exposed during the resting stage are not easily affected.

The power of the protoplasm and chromatin to absorb the radiations does not change during these periods.

The differences in the density of the chromatin during the different phases of mitosis do not affect its absorptive power.

During the metaphase when the eggs are most responsive to radiation, oxidations take place through the activity of enzymes. If these enzymes are accelerated or retarded, the effect is to accelerate or retard the rate of cell division.

Experiments indicate that radiations produced these effects on extracted enzymes.

It may be inferred, therefore, that the endoenzymes are affected in the same way and that changes in the rate of cell division, following radiation, are due to the direct action of the radiations on them.

LADD, W. E. Fractures of the Lower End of the Humerus. (*Boston Med. and Surg. Jour.*, Vol. CLXXV, No. 7, Aug. 7, 1916, p. 220.)

This article is in effect an adverse criticism of the recent work of Neuhof and Wolf, which advocates the value of early mobilization and massage in the treatment of fractures of the lower end of the humerus. According to the author, the method of reduction, the period of immobilization and the after-treatment are not in accord with experience or practice here. To prove their contention, Neuhof and Wolf should have presented cases put up in acute flexion after proper reduction, not having early massage and passive motion, and giving poor results. This they have failed to do, and the author has not found either from the literature or his own experience that such is the case. In his article he presents the roentgenograms of twenty-five cases from the surgical clinic of the Children's Hospital at Boston, with twenty-one perfect results, which were obtained by treatment contrary to Neuhof and Wolf's methods. Ladd does not even believe that the conclusions of these authors are correctly drawn, or that their results justify the adoption of early passive motion and massage as a valuable treatment. He relies upon the roentgenograms for showing the favorable results of the opposite treatment.

PETERKIN, G. S. X-Ray Efficiency in Bladder Diagnosis. (*Interstate Med. Jour.*, August, 1916, Vol. XXIII, No. 8, p. 685.)

The author is cheerful in his belief that the laity within a comparatively short time is going to push aside the inherited customs and traditions of bygone days and recognize that in order to arrive at an exact and correct diagnosis, it is necessary to obtain every bit of evidence possible.

The cystoscope no longer constitutes the whole equipment of the urologist. An urological equipment is complete when it includes not only the cystoscope, but all the aids to the special senses, as a laboratory in fact, the *x*-ray,

etc., since only through such accessories the maximum of accuracy and acuteness of the senses is obtained.

A number of beautiful, illustrative plates are given, setting forth the value of the *x*-ray as a diagnostic instrument in bladder disorders. The following points state the practical advantages of using *x*-ray in bladder diagnoses:

1. The obtaining of evidence of pathological phenomena often unsuspected and otherwise undemonstrable.

2. That media of low specific gravity, as air or oxygen, when the bladder is well distended, will give roentgenographic evidence of small and otherwise undemonstrable foreign bodies in the bladder, and sometimes of tumors, especially when employed with abdominal position advised.

3. That media of high specific gravity, as silver iodide, give evidence as to position, form, size, capacity of the bladder and the presence of abnormalities, as sacculations, etc. For instance, bladder filled with silver iodide will give outline and size of large bladder tumors. Bladder filled, then emptied of silver iodide, will often show size of ulcerations and small irregular growths, as papillomata, due to the iodide adhering to the rough surface. In females it will demonstrate the presence of bladder adhesions, and the pressure on same of tumors and other abdominal organs external to the bladder.

The bladder filled with silver iodide will give position of bladder in hernia operations, especially in children. In women with pelvic ptosis, it will demonstrate not only the presence of cystocele, but also the amount of residual urine, etc.

4. The *x*-ray will give exact data as to the size and number of calculi; information as to the nucleus of stone, if a foreign body—a factor which if not known might complicate removal; presence of calculi behind the prostate and in sacculations in the mouth of the ureter or that portion of the ureter which runs through the bladder wall—positions in which they could not be localized either by sound or cystoscope.

5. In cases of hemorrhage, pronounced inflammation, diminished bladder capacity, etc., conditions which obscure the cystoscopic view, roentgenography will often give very useful information; especially is this true in stricture, prostatic hypertrophy, etc. In the author's practice it is the rule that roentgenograms be taken in cases of prostatic hypertrophy, not only prior to operation, but subsequent thereto, in order to ascertain the effect of operation in correcting pathological conditions, especially the mechanical ones of general trabeculation of bladder, sacculation, etc.

6. A series of roentgenograms gives positive demonstrable evidence as to the progress of disease, effects of operation, etc., which is a cystoscopic impossibility.